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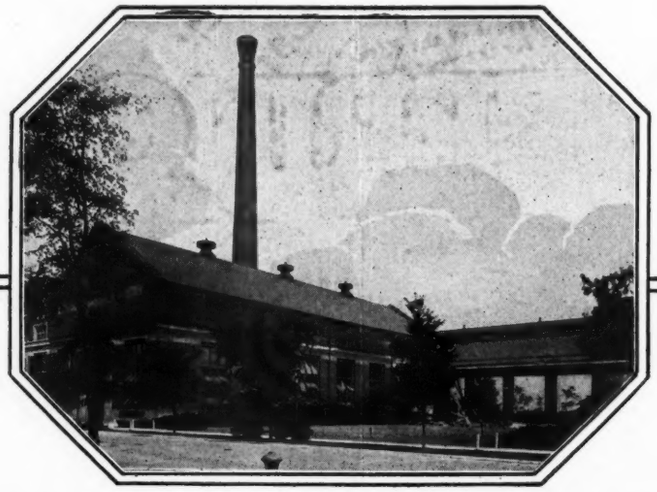
Special News Articles in This Issue:

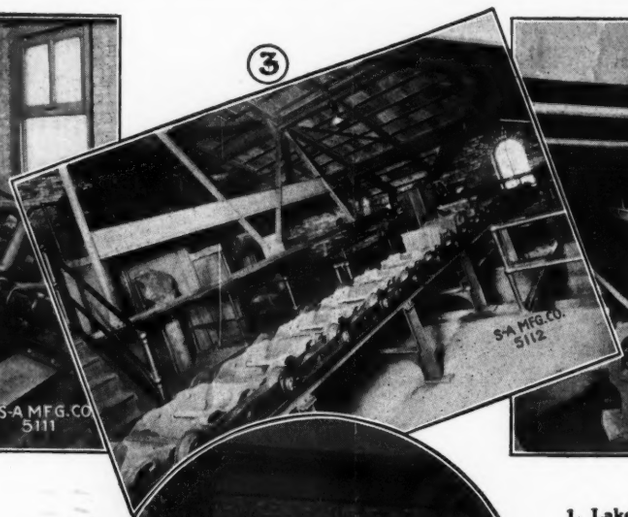
Diamonds in Arkansas

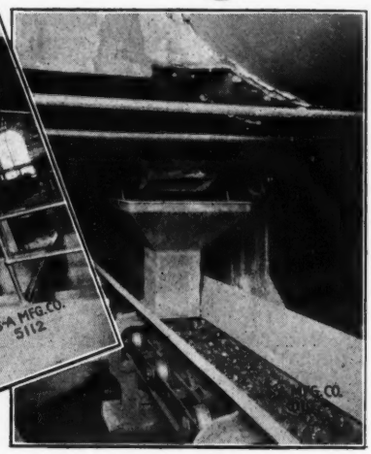
Activities of the Alvarado Mining and Milling Company in Parral, Mexico

Sketch of John Barton Payne
New Secretary of the Interior

April 24, 1920







Exterior and interior views of the Lake View Pumping Station, Chicago, equipped with S-A Coal and Ash Handling Machinery.

1. Lake View Pumping Station, Chicago.
2. Upper Bend Idler of Storage Conveyor.
3. Storage Conveyor with Overturning Buckets discharging to Boiler House Conveyor.
4. Lower Run of Storage Conveyor with Loading Spouts attached to Bunker Gates.
5. General View of Disappearing Tripper in Idle Position.

S-A Coal and Ash Handling Machinery at the Lake View Pumping Station

STEPHENS-ADAMSON MFG. CO.
Aurora, Illinois

Engineering and Mining Journal

A Weekly Journal of the Mining and Mineral Industries

METALS NON-METALS PETROLEUM

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The Consanguinity of Metal And Oil Mining

THERE is a natural line of cleavage between coal and metal mining, which results in a distinct division of interests between the two, both as regards the engineering and the industrial phases. Geographically and geologically, coal and metal mines and districts are typically far apart, the chief coal mining being in the East and the metal mining in the West. As a popular expression of this distinction of origin and locality, the dictum that "gold and coal never occur together" originated, which as a scientific statement is not necessarily exact. But the chief reason for the natural division is neither geographical nor geological, or only in part a secondary effect of these circumstances. It arises from the fact that coal, occurring in regular, extensive, and usually flat-dipping beds, is mined in a far-planning and systematic way, with many years of proven supplies ahead, with established and invariably approximate consumption, and without the hazards and extreme fluctuations of metal mining. Coal mining is a stable industry—none more so. The product is one of the most basic necessities of life and of other industries, and the output and price depend on labor and transportation more than on Nature's whimsicalities.

With petroleum mining, the geological, commercial, and psychological factors are such that the nature of the industry is not like that of coal mining. The acquisition and development of oil lands involve taking long chances and therefore winning extraordinary rewards if successful, in contrast to the meagre per-ton profits which the above-described conditions have determined for the coal industry. On account of the obscurity of the petroleum problem, petroleum geologists have come into great demand, to select the most promising fields for development and to direct the drills which sink to the invisible oil-bearing strata; and therefore geology as applied to petroleum mining has become even more popular than geology applied to metal mining, where the problems are more varied and intricate.

Metal-mining companies in the United States have found for the last ten years that it is very difficult indeed to find metal properties which may be advantageously purchased from an investment point of view. Purchasing with a view of realizing from stock sales has virtually died out, as the few sharpers who still prosecute this dangerous vocation cannot afford to purchase the property on which they base their schemes, and therefore pick up a worthless one for nothing.

Accordingly, those established companies which have accumulated a surplus with a view of continuing their business after the approaching exhaustion of their profitable mines, and so profiting by their experience and organization, have naturally looked about in a broader field for opportunities. The same holds true of mining engineers, who find the metal-mining business dull. To these the oil business appeals as one having many points in common with that to which they have been trained. There is in common the keen competition for favorable property, the speculative element in the investment, the necessity for keen judgment, and the averaging of successful and unsuccessful ventures; the abundant rewards to success, and the relatively short life of a given well or piece of property after it has come in.

The value of the petroleum produced today is somewhere near the same as that of all metals combined, including iron. It is a great and vital industry. And there are few men nowadays who are interested in the metals who have not a greater or less interest in oil. Very frequently, companies have interests in both these departments of mining; and many engineers or engineering firms conduct practice in both.

It is for this reason that petroleum has been given a special place in the *Engineering and Mining Journal*, although without diminishing the space and attention which are accorded the metals. We are gratified to find that the petroleum section has had general approval and a very satisfactory support.

The Mining Congress Gold Plan

THAT the present gold situation is a serious one must be acknowledged by all thoughtful observers. The recent fall in European exchange demonstrated that internationally the money of a country is naturally valued in proportion to the amount of real money—that is, metal—behind it. In other words, the proposition (which should be self-evident) has been demonstrated that paper money, which is the promise to pay a certain amount of gold or silver, is valueless unless there exists, in the hands of the issuing country, the metal in question; and that where such paper has value, this varies mainly with the proportion of real metallic security behind it. This has been shown to the satisfaction of nearly everyone by the relative value of the krone, the mark, the franc, the pound, and the dollar. This proposition being accepted, it follows that to be as valuable as the real metal, a paper certificate should represent its face value in actual metal, like a gold or silver certificate; that a Federal reserve note, backed by 40 per cent of metal, is of proportionately less value; and that the paper currency of the United States, consisting so largely of these Federal Reserve notes, and including, as well, Treasury notes representing no metal security, has thus been diluted, and correspondingly lowered in value and in purchasing power. This is therefore one of the causes of high prices, here as well as abroad; it is one of the causes of the decreased purchasing power of the paper dollar, and accordingly one of the causes of industrial unrest.

The ideal, in our opinion, is for governments to return to the same business standards as corporations and individuals, and do business on a solvent basis, not

running up enormous adverse balances which they can never liquidate. One element in this return to sanity would be sound money; and the road to sound money lies in putting as much metal as possible behind the currency certificates, and reducing as much as possible the volume of these certificates.

Any feasible plan that would increase the production of gold, and consequently the gold stocks, should be supported. Therefore, we should be glad to see put into effect the plan most prominently put forward at present for that purpose—that presented by H. N. Lawrie, of the American Mining Congress. This plan provides that a bounty of $10 an ounce shall be paid by the Government to producers of new gold; and that the funds for such a bounty shall be provided by an excise tax of the same amount on gold articles manufactured and sold. As the amount of gold consumed in the arts and manufactures last year exceeded the new production, it is thought that the funds thus raised will be sufficient.

Diamonds Here and Elsewhere

"THE best, sez I, is none too good," remarked Casey, as he bought his wife a diamond ring with $25 of his hard-earned money, or so the recent story runs. But, like many another story, it is misleading. Casey and his brethren are buying real diamonds and are paying the full market price for them. "No more does the rounded horseshoe nail with the head filed in the shape of a heart grace the finger of the American workingman," said a Pittsburgh jeweler at the convention of the American Jewelry Manufacturers and Importers' Association that was held in Chicago last month. "Instead, the hand that carries the full dinner pail now sparkles with diamonds, rubies, emeralds, and other precious stones. We cannot make jewelry too good or too expensive for the working classes."

The diamond is most attractive; its very name catches and holds the eye. One cannot cache his gold and silver today in a stocking without risking the contemptuous smile, but he can wear his wealth in diamonds on his shirt front and rise in public esteem. "Them as has 'em wears 'em," quoth "Fingey" Conners, and those that have them not are striving hard to get them. "There is a keen demand for the stones," said the *South African Mining and Engineering Journal* recently, "particularly on behalf of America, where, of course, the finest brilliants find a home."

According to the Treasury Department, two-thirds of the precious stones of the world, specially diamonds, are now owned in this country. The National City Bank of New York estimates that the aggregate value of the diamonds here exceeds a billion dollars. A Chicago statistician, in an idle moment, recently estimated that all the diamonds mined in history and existing today as cut and polished gems would weigh over 46,000,000 carats and in bulk make only 76 bushels.

Thus, diamonds are concentrated wealth, and in recovering them from the ground in which they occur the high ratio of concentration necessary impresses one. A huge tonnage must be washed to obtain enough carats to make even a pound of diamonds.

In Arkansas today a project is under way for testing an area of sixty acres of diamond-bearing ground. Diamonds were discovered there in 1906, since when about 2,000 stones have been found. To determine whether they are present in commercial quantity, and not simply "freaks," will require the careful washing of a hundred thousand tons or more, for which a plant is now in course of erection. Business men of repute are back of the venture. If they are successful, the supremacy of the South African syndicate will hardly be threatened. But protectionists, seeking to reduce infant mortality among industries, will have something else to talk about.

Promoting the Happiness and Efficiency Of Workmen

INCREASING wages is possibly the most common way of trying to solve a local labor shortage, but it is not always successful in the last analysis, as it may lead to less work and more vacations. Some employers endeavor to prevent such lay-offs by paying a bonus for working a certain number of hours a month. This scheme has been fairly successful, but does not tempt labor as much as an equivalent straight wage. It does, however, as a general rule, attract a better class. Some companies encourage steady men and discourage strikes by paying an increased wage to their men for each year they remain continuously in their employ, a man who has been on the payroll five years receiving more than a man who has been with the company for only one year.

A more successful alternative to the increase of wages, in many cases, is the improvement of living conditions by means of welfare work. This can take many forms, as pointed out by Dr. Darlington in an address before the local section of the A. I. M. E. recently: the provision of a good water and milk supply, sanitary sewage disposal, well-conducted schools, cheap and interesting entertainment, garden facilities, sanitary toilet and bathing facilities, well-built homes, and dozens of other things for promoting the health and pleasure of the laboring man. Expenditures for works of this kind redound to the employers' advantage by making the men more satisfied and therefore less likely to leave, and also by keeping them in better health, thus increasing their efficiency while on company time. This often works in indirect ways. Dr. Darlington gave an example of this by showing how the provision of a good milk supply, by making the babies in the camp healthier, prevented their crying at night, thereby allowing the men to get uninterrupted sleep, and the next day changing a tired grumbling employee doing about $2.50 worth of work, to a bright efficient worker earning his $6 stipend.

The improvement of conditions may, however, be carried too far. The wants of the laboring classes must be studied, and their wishes satisfied. We should supply not what we think they should have, but what they themselves want. This will make for their happiness and help to solve our labor problems. Do not put a bath tub in the house of a man until he asks for it. Rather, teach him to want it by lectures on health, by maintaining visiting nurses, and by other means.

The matter of health is of prime consideration, and, in general, money spent on medical facilities is well invested. A certain type of doctor is required. He must not be a man who gives the laborer the idea that he gets one style of treatment and his boss another. A lot of hard feeling has been bred in this way—by rough work on the part of doctors who think anything will do. Too often dental work is thought unnecessary. A good dentist is almost as important as a good doctor, and companies would do well to give dental attention on the same basis as medical attention is now given.

Tooting Your Own Horn

AMONG technical men and engineers there is an intense conservatism which is best appreciated when an engineer is put into a position where he must "sell" himself. Here the best type falls down badly, whereas a nondescript may come through with flying colors. Landing a job is an art. The job does not necessarily go to the best man. It does, however, often go to the man who is enthusiastic about himself and who does not hesitate to impart that enthusiasm to the prospective employer.

Much can be learned from an advertising salesman. Does he "toot his own horn"? Well, rather! He is a flying wedge of enthusiasm when it comes to his publication. "But does he keep within the facts?" asks the doubting engineer. More often than not, is our answer. Do you suppose that a recital of fact will always win a jury? How often is a jury swung by oratory?

Put yourself in the employer's place. He must review a number of letters, must see, possibly, a number of candidates for a given position. More often than not he is bored by the whole proceeding. All the time he may be looking for some vital quality conveyed either by the letter or by the person. If a candidate holds himself in leash, he more than likely will succeed in concealing the very qualities which are most wanted by the employer.

Not all employers are alike. Some may have such an insight into human nature as to be able to pick a good man in spite of all that individual's effort to conceal his valuable points. Others want a candidate to hurdle and hurdle high. They won't show a spark of interest unless he does. Here is a situation in which the prospective candidate can use his knowledge of human nature. It is essential to size the employer up as well as the job.

Job hunting and landing a job are only parts of a general status which may be termed the knowledge of human beings. How do they think? How do they react? One man is an excellent executive; another a good superintendent; another a good foreman; still another will win favor as a consulting engineer. All may be equally well trained from a technical standpoint. The element which makes for success, apart from technical training, is knowledge of the human element and ability to use it. Matthew C. Brush, in the *New York Tribune* of April 11, said:

> The educational institutions have improved since I graduated from Massachusetts Tech, in 1901, but their teaching is still lacking in one fundamental. They do not teach a man how to sell himself. Too often they turn out sliding rules rather than human beings. Their graduates are highly trained technicians. They know their own jobs. But they do not know how to handle men.
>
> Not a thing is done in the colleges to teach a man what man to slap on the back, what man to take by the arm when one walks with him on the street. I know where they fail, because they failed with me, and I have been observing their failures ever since. While I was still at "Tech" I worked during the summers on a lake steamer. One day old John D. Rockefeller and his entire family came aboard. Mr. Rockefeller came into my little office and sat on a high stool. He talked to me at great length, but there is one thing he said that I have remembered literally.
>
> "The ability to handle men," he said, "has become just as much a purchasable commodity as sugar, and I will pay higher for it than anybody else in the world."
>
> I believe that that ability represents about 99 per cent of what is necessary for the success of an executive, and the knowledge of how to do the job represents the other 1 per cent. The most successful men in the world are human beings. But it took me fifteen years to learn that and some other things that I should have been taught in college. I thought the big bankers and executives whose names I heard wore halos.
>
> Every time I go to New York I am asked by heads of corporations if I know of a man to fill this or that position. And these are not $5,000 jobs nor $10,000 jobs. They are posts paying $20,000 and $30,000 and $35,000 a year, and the one outstanding ability that the man must have who is to fill them is the ability to handle other men.
>
> It all simmers down to the ability to sell one's self—to the head of the corporation to get a job and to the men working under one to hold it. In the latter instance it makes all the difference in the world. If you know enough about human relationships to make men trust you and believe in you, they will work for you. And that means the difference of 10 per cent in production, or of 25 or 50 per cent, that spells success. All the technical training in the world will not do it without a knowledge of men and of human values.

We are not inclined to hold the colleges too strictly to task for not inculcating this wisdom in the raw graduate. We are of the opinion that it is up to the student and to the graduate to lay the best part of the foundation of this knowledge by his own efforts. Life is all about him. It is his for the effort. Rather would we say that it is up to the college to assist the student in acquiring individual power of initiative for his own behalf. "Tooting your own horn" and publicity are similar. Both in the best sense mean impressing your ability and your powers upon your fellow human beings, to the end that they will recognize those qualities.

The Demands of the Strikers At Broken Hill

A RECENT cable dispatch reported a settlement of the differences between the operators and workmen at the Broken Hill works, in Australia, and we sincerely hope that the negotiations resulted in a sane adjustment of the difficulties. As with our printers' strike here in New York, the disagreement began as an inter-union dispute, and started last May, resulting in almost complete cessation of mining at Broken Hill and smelting at Port Pirie. The demands of the employees, if we are correctly informed, included, among other things, a minimum wage of £1 per day for everybody, including boys; a six-hour day, a five-day week, and the abolition of the night shift and of the contract system. We cannot believe, however, that the demand for day work only, included employees at the smelter, as this department manifestly must run twenty-four hours a day.

If there is one country more than another in the grip of the unions it is Australia, and it is surprising, we sometimes think, that capital is willing to take any chances at all there. The demands outlined above are on a par with the general attitude of Australian labor, and coincide with the ideas of some of the radicals in the United States. The division of the day into eight hours for work, eight hours for sleep, and eight hours for recreation can hardly be bettered for either manual or mental workers.

General living conditions are not improving as fast as we had hoped, and the things that make for happiness and contentment are not only expensive but scarce at any price. What the workers of the world need to do, for one or more years, is to work ten hours instead of six, and to work efficiently, until supplies of manufactured products are back to normal.

WHAT OTHERS THINK

A Tip on Politics

Herbert Hoover is wanted and needed for President by the great majority of people. Reactionary politicians seem to control Republican primaries so far as gone, with the one exception of Michigan. There is still a possibility of Progressive Democrats gaining control of that party's national convention.

If mining engineers would organize a political group, non-partisan, there is a way of forcing politicians to sit up and take notice.

One of the strongest methods is to evolve a scheme to start every country newspaper in the United States, on a certain day, to taking a poll of its constituents in reference to Hoover's candidacy.

There is nothing like the concerted action of the country newspapers to make politicians of the professional type sit up and take notice.

The country vote is supposed to be a permanent and immovable quantity, switched this or that way by the professionals, while they play to the labor vote. Any apparent disruption of the country vote therefore excites the widest interest.

This is just a *private* tip from one who has "played the game" and knows some of the weak and strong points of politics. A DEMOCRAT.

Joplin, Mo., April 8, 1920.

Tungsten Tariff and National Policy

Mr. R. H. Hepburn's article in the *Engineering and Mining Journal* of March 20, 1920, concerning the protection of American citizens mining tungsten in South America, should be looked at from two angles—first, the United States, and, second, South America. Is it possible and a good policy to give this protection to American citizens in a foreign country? The tungsten situation in the United States is today different from what it was prior to 1915, and, from the present outlook, the United States should be able to supply its own demand under normal conditions.

The proposed 10 per cent duty on tungsten ores and concentrates, and their products, protected in proportion, would keep production near to what it was during the years 1917 and 1918. Why should we talk of ore depletion when our tungsten mines are merely prospects? In Colorado, and I am sure the same is true of the tungsten mines elsewhere in this country, there are mines of three classes: those worked in the first enrichment to a depth of about one hundred feet; those of the second enrichment, worked to the depth of about four hundred feet, and last, those that are called deep mines, about eight hundred feet in depth. The first two classes are only prospects, and of the last mentioned I know of only three mines that fall under this head. In the Boulder County field, a great deal of attention has been paid to the milling of tungsten ores, but mining has been neglected. When the fact is realized that underground development is the great essential in mining, production will increase. GEORGE W. COWDERY.

Nederland, Col., March 27, 1920.

The North Texas Oil Fields

In the *Engineering and Mining Journal* of March 27, 1920, there is an article by H. A. Wheeler headed "Wild Boom in the North Texas Oil Fields." Under the heading "The Black-Lime District," beginning on p. 745, Mr. Wheeler has made some statements which I beg leave to correct.

In the second paragraph he states that there are "two Bend sands at the base of the Pennsylvania formations." There are *no sands* in the Bend Series of rocks. From the top down they are made up of the Smithwick shale, the Marble Falls limestone, and the Lower Bend shale. The whole series is from 600 to 1,000 ft. thick. The Marble Falls limestone varies in thickness from 180 to 220 ft. The base of the Lower Bend shale rests uncomformably on the Ellenberger limestone, which is not Devonian, as Mr. Wheeler states, but Cambro-Ordivician. For specific information you are referred to the Revised Bulletin No. 44 of the Bureau of Economic Geology and Technology of the University of Texas, issue of 1919.

The nearest approach to true sand in the Bend formations in Eastland County, Tex., is at the base of the Marble Falls limestone on the C. U. Connellee ranch, three and one-half miles southeast of the city of Eastland, and some of the wells in the Desdemona Pool, at the base of the same formation. It has been noted by many observers that this is geologically the same horizon.

Oil occurs in the Bend Series in a disintegrated, creviced limestone at the top and base of the middle member of the series. However, the oil-bearing horizon at the base of the so-called "Black Lime" is by far the more prolific. There is another horizon at the contact of the Lower Bend shale and the Ellenberger limestone, which has produced and is now producing some oil in the Desdemona Pool and at the Vestal Well, in the southeast corner of Callahan County, near the village of Cross Plains. Most of this oil smells strongly of sulphur, and just beneath the oil there is a stratum of sulphur water.

Careful estimates made by various large operating companies point to the conclusion that the average yield per acre of the whole of the north Texas oil fields in the "Lime Areas" will be between 1,000 and 1,200 bbl. These estimates do not take into account the favorable and unfavorable geological structural conditions. Operators who employ geologists are of the opinion that the yield per acre from structurally favorable units will be on the average from 3,500 to 5,000 bbl. In this connection it may be interesting to note that one ten-acre strip on the northwest side of the Norwood anticline, described as the east one-quarter of the east one-half of the northeast quarter of Sec. 3, Block 4, H. & T. C. Railroad Co. survey, had produced from five wells up to Jan. 1, 1920, an average of 50,000 bbl. per acre. The first producer on this acreage was brought in in the first week in August, 1919. This is the Turner lease of the Albers Oil Co., situated in the Pleasant Grove area of the

Ranger Pool, and it is an exception to the general conditions. The pay horizon from which this oil came is at the base of the Marble Falls limestone, and is not a sand but a disintegrated, silicified limestone, from 3,515 to 3,560 ft. below the surface.

Mr. Wheeler states that the life of a well in north central Texas, where over-drilling has not obtained, is approximately one year. I know from personal observation and from checking pipe-line runs that in the Ranger Pool proper the average length of life of a deep well is from five to seven months. That is, a well will give up, in its flush production, in that time, from 95 per cent to 97 per cent of its total yield. However, some wells have a longer life, such, for instance, as the Gulf Co.'s H. P. Grelsford No. 1, one mile north of the city of Eastland, which was brought in during October, 1918, making 35 bbl., and in the month of February, 1920, it averaged 50 bbl. daily, pipe-line run. This again is exceptional.

There have been many misconceptions published by well-meaning students of conditions in Eastland and Stephens counties, Tex., which I have seen from time to time in *Engineering and Mining Journal*, and that is my reason for writing you now.

Eastland, Tex., April 5, 1920. JOHN R. ROBERTS.

Amalgamation of Tarnished Gold

Referring to the article on amalgamation of tarnished gold, in Silver City, Nev., in your issue of March 13, 1920, I designed, built and operated twenty- and forty-stamp mills in that district for about nineteen years, and Pierce amalgamators did not, and the "grinding pans" you describe would not, give satisfaction on ores of that and adjacent districts.

The most satisfactory pan or trap is 60 in. inside diameter and 30 in. inside depth, bottom-driven and provided with four shoes speeded to 18 r.p.m. The height of shoes is regulated by a hand wheel. On the side convenient for discharge, eight 3-in. pipe-flanges, cast to fit the arc of the span, are riveted.

A 1½ x 1½-in. groove is cast from the cone at the center to the edge of the pan, terminating in a 1-in. pipe below the bottom, from which mercury and amalgam are drawn when cleaning up. One pan or trap is used for each five stamps; often two to eight pans discharge into one, sometimes larger, final pan, and from there to reservoirs.

The best type of pan is built by the Virginia and Truckee R.R. Co. shops at Carson City, Nev. It weighs about 3,500 lb. with all shafting and pulleys, and costs approximately $900.

In operation, the pans are charged with about 50 lb. of mercury, and the shoes are raised to from ⅛ to ¼ in. above the bottom of the pan. To allow them to grind causes heavy losses in gold, silver, and mercury by flouring. Sufficient lime is added to the ore in the bins to keep the pulp slightly alkaline. The pulp is delivered near the center of the pan inside of a collar, to force all float gold beneath the surface. Additional water is added at the same place to bring the consistency of the pulp to at least one-half of what it was on leaving the plates.

Discharge is always from the top plugs or flanges until the batteries are stopped and the pulp is thoroughly thinned in case a clean-up of the pan is desired.

These pans or traps catch practically all amalgam, mercury, and partly amalgamated sulphides containing gold that escape from the plates, and give excellent results on tarnished and float gold. On Silver City ores, $2.25 tailings are given when the pans are used, but the value would be $4 or over otherwise.

Reno, Nev., March 28, 1920. HERMAN DAVIS.

Telluric Relations of Dislocative Fissure Veins

In response to your editorial "Is It True?" which appears in the *Engineering and Mining Journal* of Feb. 28, I submit the following:

That fissure veins associated with profound faults have some genetic connection with telluric tectonics seems a necessary consequence of their orderly geologic setting. That such ore veins are the direct, albeit somewhat different, expressions of the same compressive stresses which initiate mountain ranges and form the major plaits of the earth's crust appears to present small doubt. The surmise is not a wholly unexpected impression derived from casual observation and fitful acquaintance with West American ore deposits. Even the remarkable uniformity of hade and the surprising sameness of trend demand for their explanation something more than mere fortuitous occurrence. What the basic law shall prove to be may not be so far away as might be imagined. When once formulated, this law must constitute a most advantageous adjunct to modern ore exploration.

Although steep dip is the most striking feature connected with Western fissure veins, the extreme uniformity usually ascribed does not appear to be nearly so prevalent as might be inferred. There are many and noteworthy deviations. Despite the numerous apparent exceptions to rule, and a multitude of erratic examples which have yet to be brought into accord, the frequency of small hade is doubtless to be regarded as a direct function of telluric relationship. Then, too, the variable steepness of inclination may be an index of geologic age—the smaller the hade the younger the fissure; and conversely, the lower the dip, the greater the antiquity of the slipping. For this aspect there seems to be fundamental cause.

Because of the universally supposed local character of orebodies, the major or telluric relationships do not receive the attention which they really merit. On this point there are few geological phenomena which are better adapted to supply critical data than dislocative fissure systems.

Upon this very problem direct and curious bearing is derived from recent laboratory experiments in geotectonics. All of the grander relief and structural features of our planet are so perfectly and readily reproduced that the replica in miniature seems to indicate that in nature they are the immediate effects of a diminishing rate of the earth's rotation upon a heterogeneous crust or zone of rock fracture.

In the fifty-odd millions of years which have elapsed since Mid-Paleozoic times, when the sidereal day was only about one-fourth as long as at present, ample opportunity is given for crustal adjustment.

Directly associated with these major flexings are some overthrusts, which are, no doubt, much more numerous than is generally suspected. With reference to these compressive faults, dislocative fissure veins appear as subordinate expressions of the same telluric stresses. If their prevailing strike chances to be sub-

parallel to the line of overthrust relief from strain, rather than normal to it, as might be expected, it may be merely another necessary consequence of the checkered character of the rock mass.

Although it might be inferred at first thought that fissure veins originating under crustal stress should, in Western America, trend north and south, parallel to the strike of thrust-rupture and also parallel to the desert range axes, the fact that they do not does not necessarily indicate that their genesis is of minor instead of major nature, or that it is orogenic rather than telluric in its fundamental character.

The secondary aspect is seemingly more apparent than real. It actually varies continually in different mountain ranges and even in the same range. This deviation appears to be partly dependable upon tortional stress, according to the abruptness or amplitude of individual orogenic structure. The latter, of course, is entirely independent of present mountain relief, which seems to be mainly erosional in character, if latest geological advices are to be regarded.

The fact that in the majority of the desert ranges so many fissure veins seem to strike nearly east and west may be due chiefly to the illusory circumstance that because of their ore values these rupture lines are the only ones which are usually closely observed. In reality, the primary jointing system of such mountain blocks is often decidedly radially disposed, the straight side of the semicircle coinciding with the line where the steep face of the range cuts the plains level. Any local set of fissure veins is, therefore, only a limited and noticeable segment of a larger and more comprehensive scheme.

Besides the steep dips which characterize so many fissure veins and the latter's prevailingly easterly strike, there is a third notable feature which must be closely linked up with the other two. The direction of fault movement is commonly more nearly horizontal than vertical. Contrary to usual assumption, dislocative phenomena of this kind are seldom vertical and gravitational. When carefully analyzed, the slipping is found to be chiefly on the level. Associating this feature with the high dip, a warped surface is obtained the component forces of which are capable of exact mathematical expression and reference to the major telluric stresses imparted by the earth's rotative retardation.

It is not so passing strange that the latest advances in so abstruse and apparently remote a science as geophysics should have such a direct and genetic bearing upon our empirical knowledge concerning the disposition of fissure veins. We might even expect it. It is, however, quite remarkable that such a foreign speculation as the theory of isostasy, the most brilliant even though most fanciful, geologic concept of the century just passed, according to which mountain blocks are pictured as floating upon the liquid interior of the earth much after the fashion of ice-cakes in a river at time of spring break-up, should meet its severest test in the disposition of those self-same fissure veins, and should be found capable of quantitative evaluation by strictly mining methods.

CHARLES R. KEYES.

Des Moines, Iowa, March 23, 1920.

British Mining Regulations

Permit me to draw your attention to one marked instance in which British mining regulations are much more liberal to foreigners than our own. I was much surprised last summer, when prospecting in Eastern Canada (Ontario and Quebec), to find that an American (or a Chinaman for that matter) could stake out claims on government land on exactly the same terms and with precisely the same rights as a British citizen. Our own laws permit only American citizens to file on government land. I mention this to indicate that the exclusive policy concerning which we hear so much just now, in petroleum matters, is not all on one side.

A. B. MACKENZIE.

Birmingham, Ala., April 3, 1920.

Work and Sport

To get on a rock with a seven-pound double jack and blister the face of a seven-eighths steel for fifteen minutes, while hundreds of spectators yell "come down on 'er Brieny!" *is sport.* To go down a thousand feet under ground, kink your back and root into a muck pile eight hours *is work.*

In the *Engineering and Mining Journal* of March 20 the editorial "The Sport of Kings" states that they are both sport, but undoubtly the writer never crawled over a fence to watch a drilling contest when he was a kid, nor did he sink many shafts, that is, on the business end, in the bottom.

It is always interesting to read of a record being broken, as in the case of the Van Dyke Copper Co., and such a record will stand until some other company has good sinking ground, the proper equipment, and can get everything to run smooth for thirty days. Then that company breaks the record. But it is the companies which break the records, not the men, according to all reports. This is possibly right, inasmuch as the company furnishes most of the brains, good drills, lots of air, sharp steel, and good hoisting conditions, whereas the men only do the work for the pay they receive.

In the good old palmy days of Leadville and Cripple Creek, Col., the drilling contests were the big events of the year, and such men as Malley and Chamberlain, Striker and Driver, the Carr brothers, the big Swedes, and many others, when their names were called, would appear on the rock dressed in a pair of overalls and a pair of shoes. Time was called, and they were at it. For fifteen minutes seldom a blow was missed in changing steel of strikers, while the hundreds in the grand stand exercised their lungs. Then the stillness while the holes were measured and the prizes awarded, and everybody was happy, as the losers "got in" on spending the money. The names of the winners were sent to every mining district in the world by the press; they were heroes in the mining game, especially if a record was broken, and each contest raised the limit.

The honor of breaking the shaft-sinking record should not be taken away from these men, but it would have been impossible for them to achieve such a record had not the company furnished the mechanical part of the work, which was the main part of it. The men, when they came off shift, undoubtedly looked for a place to rest, instead of going out to celebrate, as was the case with the driller after a contest.

The press and mining journals state that a record was broken by a copper-mining company or an iron-mining company, and tell what it was, but the names of the men who push the "muck stick" do not appear, except in a local paper; so where is the sport?

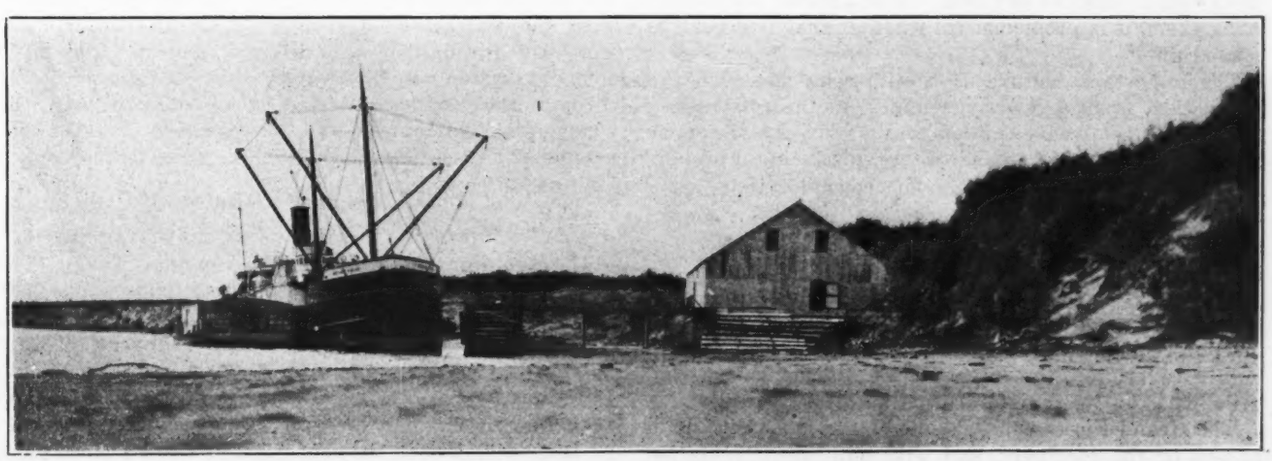
This is not a criticism. Your article was the *work* of an editor. This is the *sport* of a "mud digger."

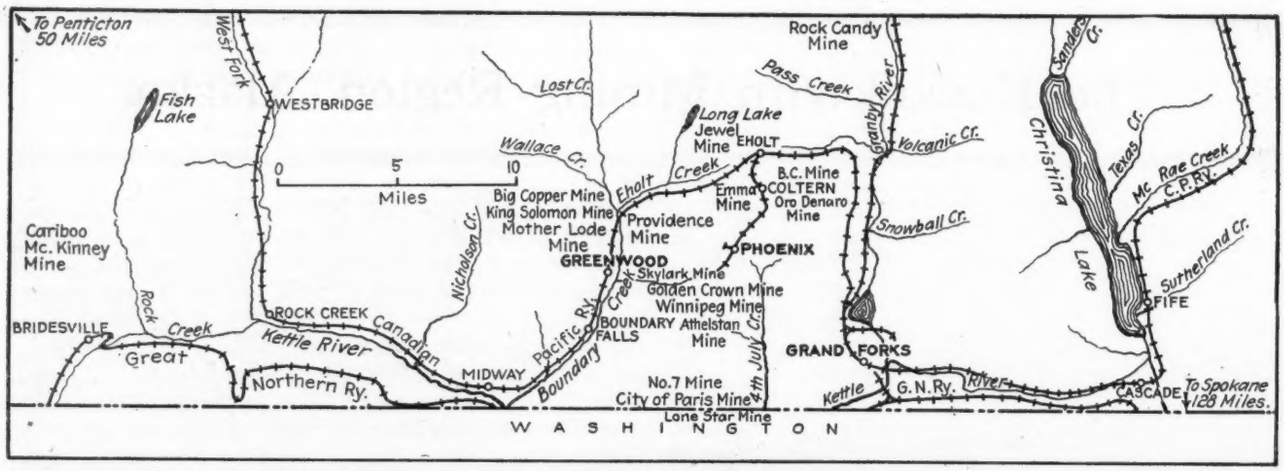
Johnson, Ariz., April 6, 1920. HARRY E. SCOTT.

The Kuskokwim Mining Region, Alaska

THE KUSKOKWIM is the second largest river in Alaska, lying between the Yukon and the Aleutian range of volcanoes. The lower part of the river is wide and navigable. The lower photograph shows an ocean steamer unloading at Bethel, 150 miles up the river, where there is seventy-two fathoms of water. The upper picture shows a crew of natives (Indians and Eskimos) in their boat of walrus hide, ready for a race.

The Kuskokwim and its tributaries run through districts carrying placer gold, and several parties are at work or are about to start. Gold valued at $100,000 was shipped out from one dredge last fall. Mercury mines occur on this river and are being developed. There is an established population of 1,000 whites and several times that number of Indians and Eskimos. Considerable agricultural land is not yet utilized. This is a region which is bidding for further development. Though the gravels on the Yukon are frozen, it is claimed this is not the condition on the Kuskokwim.





MAP OF BOUNDARY DISTRICT

Boundary District, British Columbia

Picturesque Region Close to International Boundary Line Has Made Within Twenty Years Twenty Million Tons Production of Low-Grade Copper Ores—History Of Mine Discoveries and Development

BY C. M. CAMPBELL

Written exclusively for *Engineering and Mining Journal*

THE BOUNDARY district of British Columbia comprises a strip of territory extending along the international boundary line for approximately forty miles between Christina Lake and the Kettle River, and directly north of Spokane, Wash. The area includes part of the Midway Mountains and the Christina Range of the Columbia system of mountains.

Topographically, the district consists of a series of rounded hills, having a general northerly and southerly trend, and usually reaching a height of 5,000 ft. above sea level, but with a few higher altitudes. The Kettle River valley, which traverses the district, has an average elevation of 1,900 ft. The mountains are generally heavily timbered, particularly on the northern slopes. For this reason, and also owing to the heavy covering of drift, prospecting has been limited largely to an examination of the outcrops. A few years previous to and after 1900 were sufficient for this work. Practically all the prospects that have amounted to anything were discovered and staked at that time. Probably there are other orebodies under the overburden, but, with present lack of knowledge of any practicable method for discovering them, it is problematical whether they will ever be opened up.

The important feature of this district has been the production, from a few large mines, in the last twenty years, of over twenty million tons of low-grade copper ore. Numerous other smaller mines, producing a higher-grade product, and a few gold placer locations have helped to increase the mineral production. The ore deposits have now been largely worked out, and the distinctively mining phase of the district has passed.

For reasons already mentioned the chances are against the discovery of mineral locations of sufficient merit to change this conclusion. Though some mining will be carried on, the future of the district will depend principally on its agricultural possibilities.

The Grand Forks valley is one of the most delightful valleys on the continent, and with additional irrigation will become a much more prolific producer of fruit than at present. Other parts of the district are also suitable for agriculture, and timber resources are considerable.

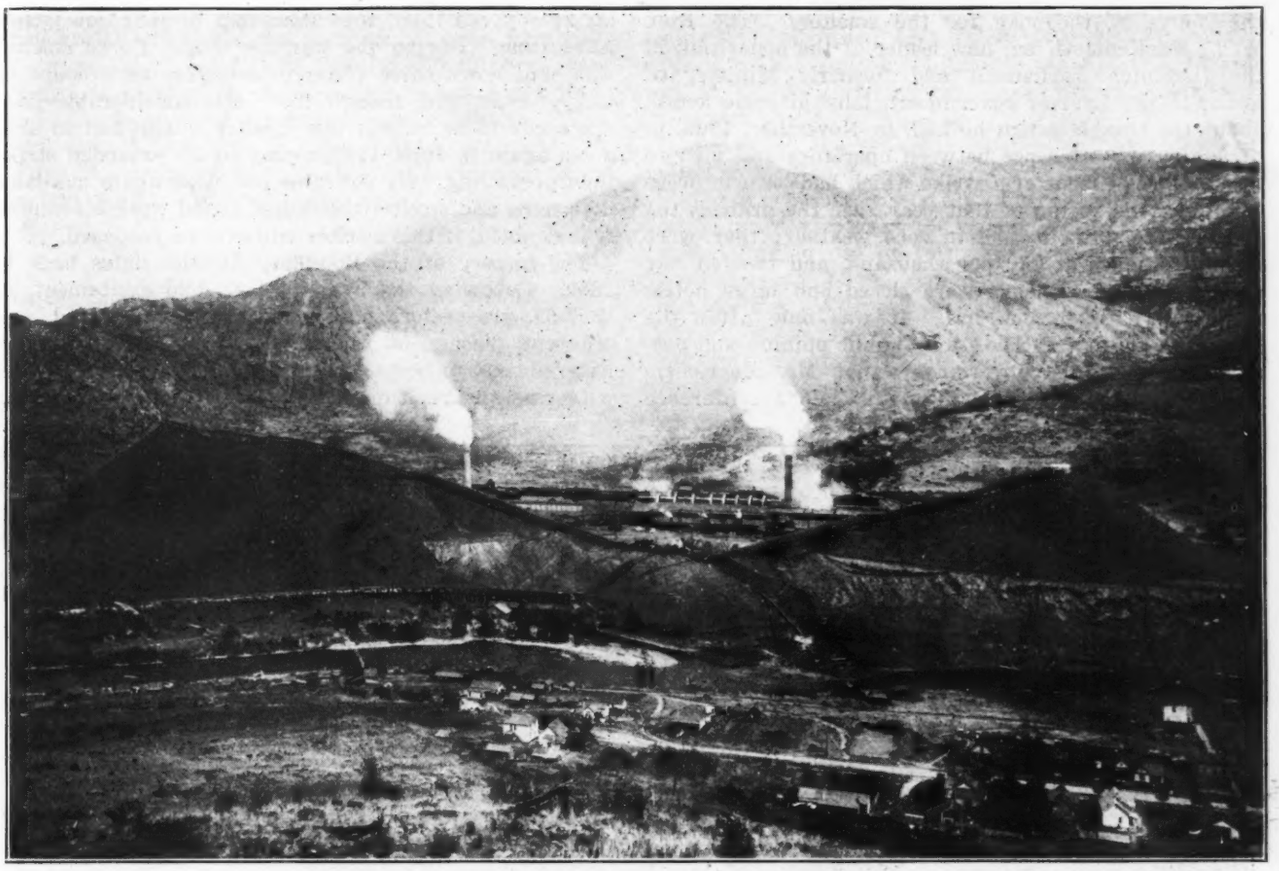
CLIMATIC ADVANTAGES

The climate is particularly pleasant. This, together with the picturesque nature of the country, the productive quality of the soil, good educational advantages, lack of labor troubles, excellent highways, and adequate railway transportation facilities, has made the region an exceptionally desirable place in which to live. The mean temperature for January, the coldest month, is about 20 deg., and for July and August about 65 deg. Extreme temperatures occur but seldom and then not for any considerable length of time. Some winters pass without the thermometer registering below zero. Phœnix, which has an elevation of 4,600 ft., has a precipitation of twenty inches, and the valleys show only about twelve inches.

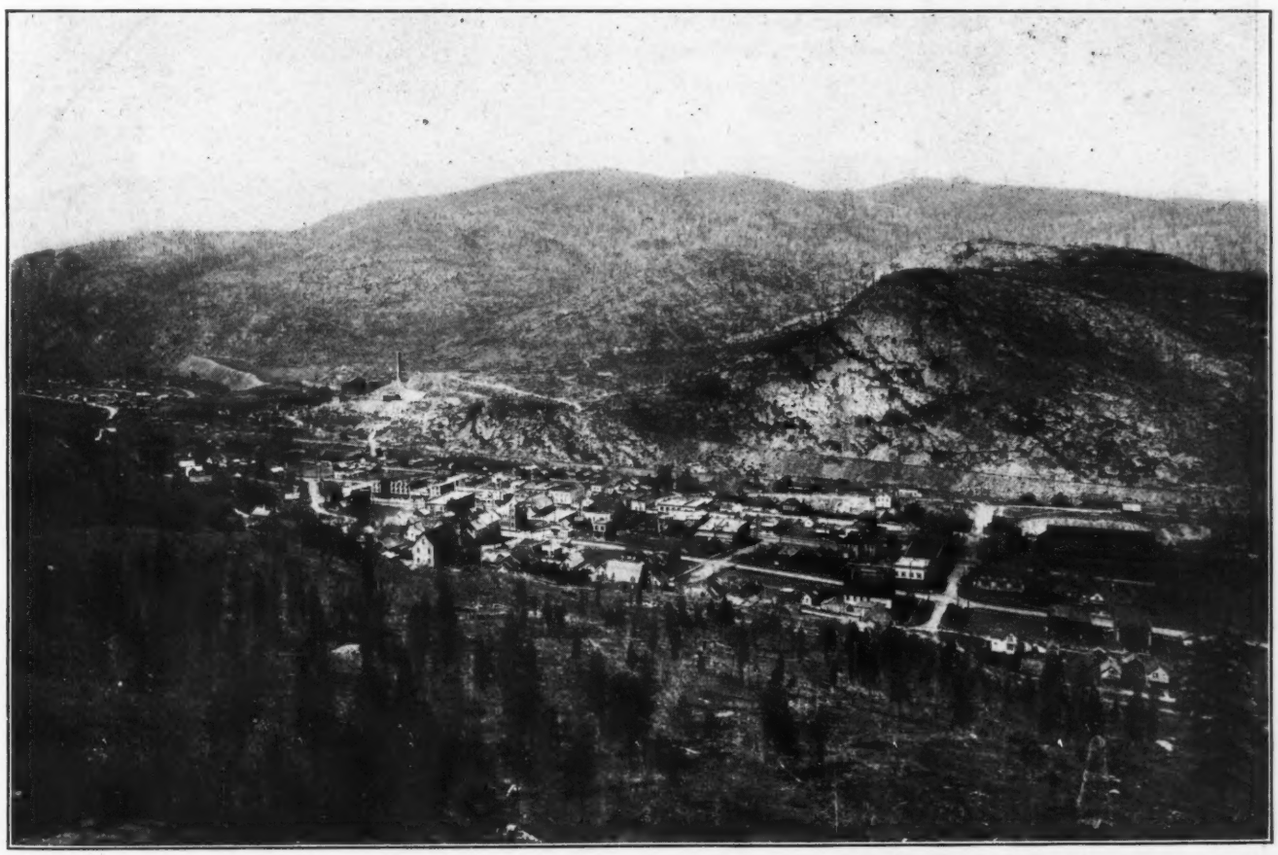
The trans-provincial highway reaches all the important points, and on this road the provincial government has done efficient work, with liberal expenditure. This, with the help of good road material distributed conveniently throughout the district, has resulted in a splendid system of highways, which extend not only through the Boundary but also westerly through the Okanagan, Similkameen, and Nicola valleys. Better connection with Rossland and other districts to the east is now under consideration.

DISCUSSION OF LABOR TROUBLES

Metal-mining operations in the Boundary, as well as in other parts of southern British Columbia, have, so far, been free from labor troubles. With the exception of a few weeks' shutdown while labor difficulties were being adjusted after the drop from the high prices in 1907, there have been no industrial disturbances whatever. The district has, however, been hampered seriously by labor difficulty in the coal fields of Crow's Nest Pass,



THE GRANBY SMELTER AT GRAND FORKS, BRITISH COLUMBIA



GREENWOOD, B. C. THE BRITISH COLUMBIA COPPER CO.'S SMELTER IS AT THE LEFT

the source of the coke for the smelters. The Hon. W. L. MacKenzie King, now leader of the opposition in the Dominion Parliament and formerly Minister of Labor in the Laurier government, tells[1] at some length about the trouble which he had, in November, 1906, in arranging a conference between operators and men to discuss a settlement of a strike which had been in progress since the spring of that year. On the prairies the people were without fuel in zero weather; they were burning lumber at $30 per thousand, and twisted hay and grain. The schools were closed and large hotels were restricted to one fire. It was only after the greatest difficulty, backed up by public opinion and possible action of the government, that Mr. MacKenzie was able to induce the operators to join a conference with the representatives of the men, as a result of which work was resumed.

Since that period and the introduction of the Lemieux Act, calling for an investigation before a strike takes place, there has been little change. Law or no law, agreement or no agreement, war or no war, the labor executives in the Crow's Nest Pass district have never hesitated to call a strike on the least provocation, no matter how much their action might cause other people to suffer. Industries from Winnipeg to the coast which have had to depend on the product of these mines have always had to store large quantities of coal or coke, at great expense, in order to be prepared for one of these strikes. Even then, they have had to shut down time after time. During the war the Grand Forks smelter was shut down three times in one year on account of lack of coke, and, though there was considerable good ore ready to be mined, this smelter finally had to shut down again in June, 1919, owing to the extended strike then prevailing. By the time coke was again available both mine and smelter crews had found work elsewhere. It is doubtful if this smelter will ever be reopened.

The history of the Boundary district dates back to 1860. Following the Fraser River gold excitement, in 1857-58, prospectors penetrated farther eastward, and different placers on the Similkameen and Tulameen Rivers began to be worked in 1859. The year following witnessed the rush of 2,000 miners to the Rock Creek placers, in the Boundary district. Boundary Creek was also the scene of active placer work. To facilitate transportation, the Dewdney trail through southern British Columbia was constructed about that time.

TYPICAL BOUNDARY LANDSCAPE

In the middle foreground is the upper part of Greenwood (elevation 2,400 ft.). At the upper left is the lower part of Phœnix (elevation 4,600 ft.). The power line from the Bomington Falls to Princeton is shown at the right.

The scene of placer activities then shifted to the Cariboo and East Kootenay, and the Boundary district subsided again almost to its primeval condition. In 1884 the gold ledges of Camp McKinney were discovered, and, some years later, several mines, of which the most important was the Cariboo-McKinney, came into existence. This mine, with a production of $1,000,000 in gold, of which sum $546,000 was paid in dividends, was worked out by 1903 and abandoned. Camp McKinney was one of the oldest lode-mining camps in the southern part of the province. With the possible exception of

[1] "Industry and Humanity," by W. L. MacKenzie King, pp. 505-510.

Ainsworth Camp, it antedates in its mining operations better-known metalliferous districts such as Rossland, Nelson, and the Slocan. The Cariboo was the first free-milling quartz mine in the province to pay a dividend. The head office of this company was in Toronto. The directors in 1898 were: Robert Jaffray, president; H. M. Pellatt, vice-president; G. B. MacAulay, managing director; S. W. McMichael, treasurer; A. Ansley, and G. B. Smith.

Later History of Mining

In the course of time prospectors began to work their way up Boundary Creek, using the Dewdney trail as a base for their operations. Between 1884, the time of the discovery of the Cariboo-McKinney, and 1890, several claims, none of which developed into mines, were staked. The Dewdney trail not only was in evidence in the Boundary district but was being utilized by prospectors over its entire length. Fifty miles to the east a band of prospectors were exploring along the headwaters of Trail Creek.

The years 1900 and 1901 were extremely important in the annals of the mining industry in southern British Columbia, as, during the first year, the claims known as Le Roi, Centre Star, and War Eagle were staked on Red Mountain, and, in the following year, the Mother Lode, Knob Hill, Old Ironsides, and other claims which eventually formed the chief assets of the Granby Co., the British Columbia Copper Co., Ltd., the Dominion Copper Co., and the Montreal & Boston Co. were located.

Rossland soon had railway connection with the outside, but it was not until 1900 that a spur from the Columbia & Western branch of the Canadian Pacific R.R. reached Phœnix. In the meantime freight had been teamed into the country from Bossburg, sixty miles distant on the Great Northern line between Spokane and Rossland. The Great Northern followed the Canadian Pacific RR. into the country in 1902, reaching Phœnix in 1904. The Phœnix branch, over which 8,000,000 tons of ore had been transported, was taken up during the winter of 1919-20.

By the year 1900 all the leading mines were developed to a considerable extent and the smelters of the Granby company at Grand Forks, the British Columbia Copper Co. at Greenwood, and the Montreal & Boston Co. at Boundary Falls were under construction. In August, 1900, the Granby smelter was blown in; the Greenwood smelter started operations the following February, and the Boundary Falls plant some time later. There were soon nearly 10,000 people in the district, and until recently the Boundary maintained its importance as a mining and smelting center of note.

The Granby Consolidated Mining, Smelting & Power Co., Ltd., to give it its full name, was an amalgamation of several mining companies at Phœnix with a smelting and power company at Grand Forks. The amalgamation took place in 1901, and the new company started work with the following directors: S. H. C. Miner, Granby, Quebec, president; Jay P. Graves, Spokane, Wash., vice-president and general manager; A. C. Flumerfelt, Victoria, B. C., assistant general manager; A. L. White, Montreal, secretary; Fayette Brown, Montreal, and J. H. McKechnie and W. A. Robinson, both of Granby, Quebec. A few years later New York interests purchased the greater part of the eastern Canadian stock and assumed control. The resident officers in the early days were G. W. Wooster, treasurer; W. Y. Williams, mine superintendent, and A. B. W. Hodges, smelter superintendent. With the development of the mine, the acquisition of other properties, and with increased capacity at the smelter, shipments reached their maximum in 1913, with an ore tonnage of over a million and a quarter.

The cost of the crushed ore, on cars, including all development, was 75c. per ton. The transportation to Grand Forks was 25c., and the smelting and converting charges were $1.20 per ton. The low costs permitted the handling of ore of very low grade. In 1913, the recovery was 17.68 lb. of copper and 75c. in gold and silver per ton. With the increase in the price of copper, lower-grade ore was worked, and 1917 showed a minimum recovery of only 13.52 lb. and a similar gold and silver recovery. As the slag loss was slightly under four pounds, this recovery represented ore with an original content of less than 0.9 per cent copper.

The total tonnage of ore smelted at Grand Forks was close to 14,000,000 tons, nearly all of which was from the company's mines at Phœnix. The Granby company, realizing that the Boundary reserves were limited, some years ago acquired valuable copper claims on Observatory Inlet and has since erected a smelter and equipment at Anyox, now the chief asset of the company.

Story of British Columbia Copper Co.

The story of the British Columbia Copper Co. is much the same as that of the Granby. The company was organized in 1898, with the following directors: J. F. Tichenor, president; F. L. Underwood, vice-president; C. E. Laidlaw, treasurer; Paul Babcock and Col. H. T. Horton, all of New York. Frederic Keffer was local manager and Paul Johnson was smelter superintendent. The Mother Lode mine was the principal ore supply, but, the limits of the orebody having shown it to be good for only about four million tons, other properties in the district were eventually acquired.

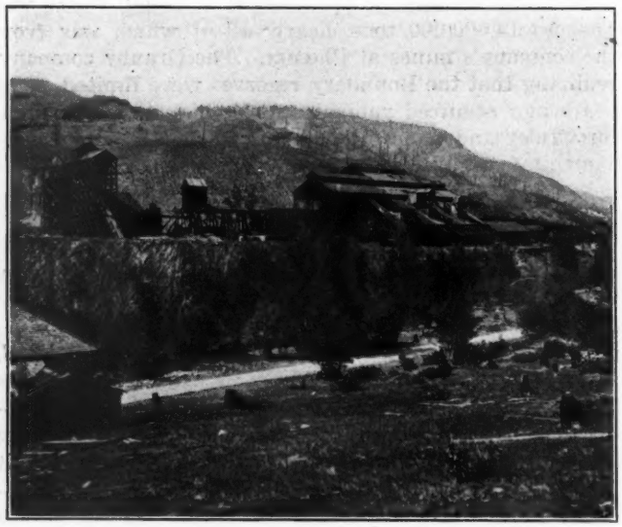
The Boundary Falls smelter, owned by the Montreal & Boston Co., depended on the Sunset group of mines, near the Mother Lode, for its ore supply. As this was limited to about 100,000 tons, the company amalgamated with the Dominion Copper Co., owner of valuable copper properties in Phœnix. The new company, after working for some time as the Montreal & Boston Co., the Dominion Copper Co. and the New Dominion Copper Co., finally passed under the control of the British Columbia Copper Co. The Boundary Falls plant, after smelting over 500,000 tons, was then dismantled, and the remaining ore was treated at Greenwood.

Other properties, including the British Columbia mine, Emma mine, and Oro Denoro mine, all near Coltern, were also acquired, and the furnaces were kept going until 1918, when the exhaustion of the reserves caused a shutdown. More than 5,000,000 tons was treated at this smelter. While operating in the Boundary district, exploratory work near Princeton, in the Similkameen mining division, had opened up a valuable copper deposit containing a positive reserve of 11,000,000 tons, and the British Columbia Copper Co., under the name of the Canada Copper Corporation, has developed this property and constructed a mill. With the completion of a branch railway and power line this summer it will be in a position to ship concentrates.

Mining Methods and Large-Scale Blasting

The grade and character of the ore handled by the British Columbia Copper Co. were much the same as those of the ores handled by the Granby company. Min-

ing and smelting practices were also much alike. One outstanding feature of the mining was that the ore, as a general rule, was mined by large open stopes supported by rock pillars. Later the pillars were blasted and removed, the roof usually caving in course of time, if not at once. The method allowed for a large percentage of extraction, with no expense for timber in the stopes. From one of the Granby stopes 400,000 tons was extracted, the stope remaining open for a year after the last pillar had been drawn. Often, several pillars would be blasted at once and drawn. The practice was brought to perfection at the Mother Lode mine, and this mine probably holds the world's record for the largest underground blast ever set off. After all the solid ore in the mine had been exhausted, work was started in removing, in sections, the pillars, floors, and backs remaining. On one occasion 4,830 holes of an



BOUNDARY FALLS SMELTER AS IT NOW APPEARS

average depth of 15 ft. were drilled. They were charged with 100,000 sticks of 40 per cent powder, and all were blasted at once. The blast was a complete success.[2]

Much of the Granby ore was found in widely separated orebodies, and a more efficient haulage system was needed than was known at that time. The principal item in the resulting improvement was the introduction of the Granby type of automatic side-dumping ore cars. These cars, fitted with M. C. B. couplers and roller bearings, running on good track, with easy curves and grades, and hauled in long trains by powerful motors, were an important factor in reducing costs to a minimum.[3]

Low smelting costs were due essentially to the predominating fluxing qualities of the ore. Nothing was added to the furnace charge except coke. The Boundary smelters were among the first to introduce mechanical charging apparatus. Later the Granby smelter found it necessary to introduce a new method of slag disposal. The available areas were being filled up, and the former method of granulating the slag was reintroduced, but, in this case, the slag was stacked by a system of belt conveyors. Over 5,000,000 tons has been disposed of in this manner.[4]

[2]"The Mother Lode Blast," by F. S. Norcross, Jr., *Engineering and Mining Journal*, Vol. 99, p. 931.

[3]Details in *Engineering and Mining Journal*, Vol. 101, p. 354 and Vol. 102 p. 1,058.

[4]"Matte-Settlement and Slag-Disposal at Grand Forks," by Walter B. Bishop. *Mining and Scientific Press*, Vol. 116, p. 819.

In addition to the mines mentioned, there were about fifty other properties which reached the shipping stage. Some of these were of sufficient importance to warrant brief mention. In the neighborhood of the Mother Lode, in addition to the Sunset, were the King Solomon and the Big Copper mines. The first consisted of a lens of high-grade carbonate ore, of about 900 tons, which was mined and shipped in 1901. The Big Copper, notwithstanding its spectacular outcrop, was a shallow deposit of a few thousand tons, containing chiefly low-grade native copper ore. The two properties were unique, as they represented the only occurrences of these types of ore in the region.

Between Greenwood and Phœnix, and extending between the Skylark and Providence mines, there was an area known as the high-grade belt. This area comprised about twenty mines, all producing gold and silver ores, and in many cases remarkably rich shipments were sent out. The Providence is the only one now working, and work at this mine is on a small scale. All the deposits were of small size and so badly broken up that, with the possible exception of the Providence, they have not been financial successes.

MINES IN AND ABOUT PHŒNIX

In addition to the Granby company there were also operating in Phœnix, in the early days, the Dominion Copper Co., the Gold Drop Mining Co. and the Snowshoe Gold & Copper Mines. The Dominion Copper Co. owned the Brooklyn, Stemwinder, Idaho, and Rawhide, all of which were important shippers, particularly the last mentioned. This company had its head office in Toronto, and had as directors the Hon. G. A. Cox, William McKenzie, D. D. Mann, E. R. Wood, and Hugh Sutherland. Frank Robbins and James Breen had charge of early development at different times. These mines eventually came under the control of the British Columbia Copper Co., as already mentioned. The Gold Drop Mining Co., with T. C. Brainard, of Montreal, as president, and Stanly A. Easton, mine superintendent, had blocked out a considerable tonnage of low-grade ore, and instead of going further on its own account sold out to the Granby company in 1905. The Snowshoe company also played a considerable part in Phœnix operations. This was an English company, the officers of which were: Earl of Chesterfield, chairman; G. S. Waterlow, vice-chairman; H. W. Batty, secretary; A. J. McMillan, managing director; J. W. Astley, mine superintendent, and J. H. Trevorrow, mine captain. For some time this company operated the mine, making shipments to different smelters. The Consolidated M. & S. Co. then obtained a lease and shipped 600,000 tons to Trail. When the lease was given up, the mine was purchased outright by the Granby company.

South of Phœnix, the Golden Crown and Winnipeg mines, owned by Manitoba people, produced a small tonnage in the early days. The same was the case with the No. 7 and City of Paris mines, near the boundary line. The Athelstan, a Dominion Copper property, shipped for several years to Greenwood. The Lone Star mine, with several hundred thousand tons in sight, is also a British Columbia copper company property. The ore from the mine, however, is refractory, and only the better grade has been shipped. It was handled over a five and one-half mile tramway to Boundary Falls and from there by rail to Greenwood.

North of Phœnix an important tonnage was produced in the neighborhood of Eholt and Coltern. The Oro

Denoro mine, between 1903 and 1910, shipped 150,000 tons of typical ore, principally to Greenwood. For a while the ore was put on the cars for 40c. per ton. This charge included all mining costs. A similar quantity or iron fluxing ore was also obtained from the Emma and shipped to various smelters. The Emma is now owned by the Consolidated M. & S. Co., and ships to Trail. The B. C. mine, developed by a Montreal company, with S. F. Parrish in charge, shipped 100,000 tons, of much higher-grade ore than the usual type of the district. Most of the ore averaged 5.8 per cent copper, 2.45 oz. silver, and 0.015 oz. gold per ton. It made its last large shipment in 1903 to Greenwood. The Jewel mine contained gold quartz ore, and was worked on a small scale from the early days until recently. A few hundred tons of fair grade ore was shipped from the Fife mines, on the eastern shore of Christina Lake. Large lime quarries in this region have produced for many years the necessary flux for the Trail smelter.

The Beaverdell camp, twenty-five miles north of Westbridge, and Franklin Camp, forty miles north of Grand Forks, are tributary to this district. The mines at both places are small, and produce at some profit a limited amount of fair-grade gold and silver ores. The properties are now operating, and ship intermittently to Trail.

The principal mining work in the district, however, is now being done at the Rock Candy mine. The orebody here is fluorite. It is being developed and worked by the Consolidated M. & S. Co., and may prove to be a large deposit. The ore is transported by means of a rope tramway to the railway, where it is concentrated. Shipments amount to approximately 100 tons per day.

Mining in Sonora

BY B. R. RUSSELL

Written exclusively for *Engineering and Mining Journal*

NOTWITHSTANDING the unsettled political conditions in Mexico, the Moctezuma district and adjacent territory of the State of Sonora witnessed a fair amount of mining activity in 1919. It is a fact that this district, remarkably rich in mineral, has been only superficially prospected and explored, and with settled and peaceful conditions firmly established in the country, this locality gives excellent promise of quickly becoming a mining center of tremendous importance.

The Pilares Mine of the Moctezuma Copper Co. (Phelps Dodge subsidiary) is the largest producer in the district, or, for that matter, in all of Mexico, yielding, principally, copper ore of low grade, which is concentrated in the company's mill at Nacozari, and shipped to the Copper Queen reduction works at Douglas, Ariz., The Pilares is a splendid example of modern mining efficiency, and the mine and mill are thoroughly equipped in every respect. Under normal conditions, the mine employs from 2,000 to 3,000 men, producing about 3,000 tons of ore daily. The concentrator, ideally situated upon a steep hillside, is a wet-concentration plant, and for the last ten months the company has been conducting a series of experiments, resulting in the elimination of much of the former equipment, rod-mills and oil flotation now being used almost exclusively.

The Pilares orebody is acknowledged to be one of the most important copper porphyry deposits yet discovered, both as regards extent and enrichment. On the southwest, and adjoining the Pilares mine, lies the property of the Nacozari Consolidated Copper Co., an Arizona corporation, which has been under steady development for several years. The company claims a full extension of the great Pilares orebody, and the main adit, 4,000 ft. long on Nov. 1, 1919, shows copper mineral of close similarity to Pilares, and of increasing value and quantity as the adit advances. The company expects to uncover commercial ore in great quantity within the next 200 ft., and at present is producing and marketing high-grade silver-lead ore from the San Pablo portion of its holdings. A small mill was erected during the early development stage, and large equipment, including a smelter, is planned as soon as the ore tonnage warrants the installation. The outlook for the company for the future is considered to be highly promising.

SAN NICHOLAS OREBODY RICH IN SILVER

The San Nicholas is another property in this district, being operated by the Cia. Mexicana Desarolladora de Minas, S.A., under lease from the Transvaal Copper Co. The present production is about thirty tons of silver-lead concentrates per month, produced in an oil flotation plant. The silver content is said to be high.

H. J. Wendler is operating the Buena Vista mine, in the Lampasos district, about 100 miles south of the town of Nacozari, and the completion of a wet-concentration mill has just been reported. The concentrates are being smelted at the property, and silver-lead bullion is being exported to the United States.

El Progresso mine, about 175 miles south of Nacozari, in the Batuc district, reports that its new cyanide plant has been completed and is in operation. A wagon road has been built from the property to the town of Moctezuma, a distance of about sixty miles, and the transportation of ore and supplies will be accomplished with motor trucks. This property is a substantial producer of gold and silver.

Numerous other mining properties are being operated in this section. Labor is plentiful and wages are low; the climate is salubrious the year around, and, with a fuller guarantee of peaceful conditions, this portion of northern Sonora should prove most attractive to those interested in the mining industry.

Shipped Without Delay

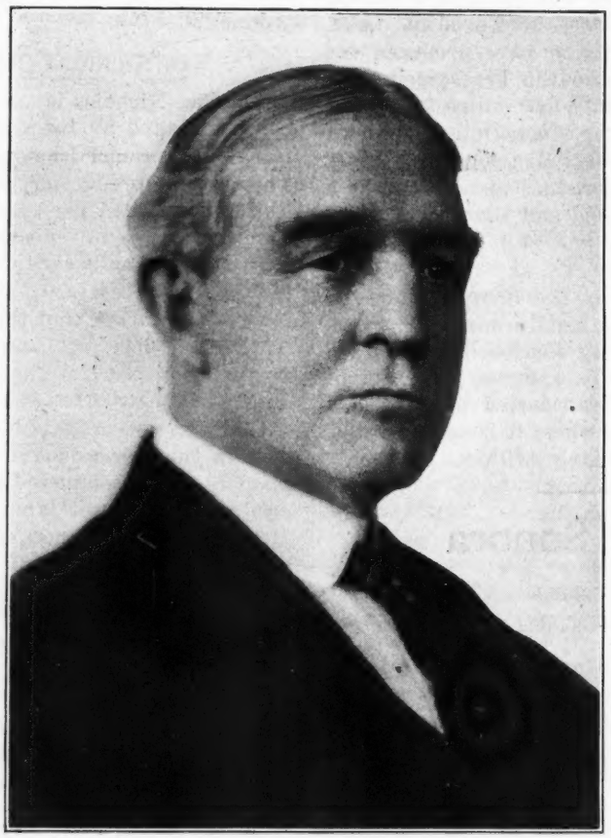
A tale is told of a certain well-known mining promoter who had a large copper furnace on his hands at El Paso, one that had been destined for Mexico, where mining necessarily had been closed down. He met a smooth-tongued fellow who sold him a long-time option on a copper mine near an Arizona camp. So to Arizona forthwith the furnace was shipped, a clever mine superintendent following. He found the smelter material dumped at a siding, but was absolutely unable to find the mine for which it was intended. There were claims near by, but there was no ore and no development. So he wired his resignation. The furnace was shipped elsewhere and was erected at a copper mine where its operation was a matter of days only, for the ore was a low-grade surface carbonate for which no fluxing material had been provided. Somewhat in the same line is the tale of a northern Arizona mine manager whose first task on arrival was to build himself a brown sandstone residence. Thereafter the fact was determined that the mine was not worth working.

Government Officials Who Influence Mining

Judge John Barton Payne

BY PAUL WOOTON
Written exclusively for *Engineering and Mining Journal*

AMERICANS are inclined to look upon legislation as a panacea, in the opinion of John Barton Payne, the new Secretary of the Interior. As a result, Judge Payne believes, initiative, which otherwise would be asserted, is dulled waiting for the magic change which is to follow the passage of this or that bill. In expressing this opinion to the correspondent of the *Engineering and Mining Journal*, Judge Payne had particularly in mind the oil situation, but he specified that there is a demoralizing general tendency on the part of the business men of the United States to rely too strongly upon legislation. Judge Payne comes to the Department of the Interior with petroleum problems uppermost in his mind, as a result of his latter-day experiences as chairman of the Shipping Board, when that organization found it impossible to secure bids for its fuel-oil requirements. He fears that American capital and America's technical petroleum men are waiting for Congress to take some action which will make it easier for them to search out petroleum deposits in foreign countries. He believes that American enterprise should be asserted—that American petroleum geologists in the service of American companies should be diligently searching for formations favorable to the occurrence of oil.



JOHN BARTON PAYNE

When Judge Payne pulled his chair up to Secretary Lane's old desk and rang for John Harvey, an old Interior employee who is acting as his secretary, there was the utmost surprise on Harvey's face when Judge Payne told him that his door was to be left open. That was an innovation that the office force failed to understand. The old staff knew that a real multitude of callers fall to the lot of the Secretary of the Interior. Just how Judge Payne was going to maintain his "open-door policy" they were at a loss to understand. They soon learned, however, because Judge Payne is a genius in leading his visitors to the point. He manages to draw from them in a few lean sentences the real purpose that they have in mind, when ordinarily they would have gone voluminously into discourse. As Dr. Frank Crane says, Judge Payne is a skilled surgeon who knows how "to relieve the boil of eloquence with one sure and merciless stroke, who pricks garrulity, and taps those who are all swollen up with millions of words."

There is reason to think that Dr. Crane is right and that the open-door policy is going to be a success, because the stream of visitors into and out of Judge Payne's office has had its flow accelerated to the extent that the stream frequently runs dry—a rather unusual occurrence in the office of a cabinet secretary. The stained-glass windows in the private office of the Secretary of the Interior do not suit the incumbent of that office. He wants to see out. One of the first things he did was to order a high desk, so that he could stand up and work by the window. Now that spring is here he can open the window and look out. "How can I see the progress being made on the Alaskan railroad if I cannot see out of the window?" asked Judge Payne. "How can I see the activities of these thousands of engineers who are working with me unless the window is open? I am going to stand by that window and look out over the public domain, over the mining camps, over the oil fields, and over the numerous other activities that fall to the duty of my new office, and I am going to do my best to direct these activities along broad lines, that the public may benefit and that the country may know that the money being expended by the Department of the Interior is bringing in a high rate of return."

Judge Payne is a native of Virginia. His education was obtained in that state. He was admitted to the bar in West Virginia in 1876. Much of his legal career has been spent in Chicago, where from 1893 to 1898 he was Judge of the Superior Court of Cook County. He has served as general counsel for the Shipping Board and the Emergency Fleet Corporation and for the Director General of Railroads. He was chairman of the U. S. Shipping Board from Aug. 7, 1919, to March 4, 1920.

By The Way

Patriotism as a Cause for Mining War Minerals

"So much has been said relative to patriotism being the cause of going into the production of war minerals, that it is quite refreshing to learn of an instance wherein that motive actually applies," said a traveling auditor of the Bureau of Mines recently, who had been co-operating with the War-Minerals Relief Commission. "Patriotism is a very commendable trait, and to be expected. It is something that is looked for in every American. It should be just as deeply rooted in times of peace as during the chaos of war. It seems, however, that some reverse the sequence. America has become the greatest place on earth because real Americans think of their country first, then their state, county and city in regular order, and themselves last. A reversal of such an order relegates patriotism to the revered pages of 'Joe Miller's Jest Book.'

"In order that there may be a full appreciation of this exemplary American, it will be necessary to draw a mental picture along the following lines:

"A small village on the Pacific Coast inhabited to a large extent by American Indians. A Government auditor arrives carrying a bulging portfolio. He registers at the hotel as coming from Washington, D. C. The fire alarm is sounded, and the natives, who, by the way, had all worked for a war-mineral operator, arrive. The portfolio is noticed, and it suggests a goodly supply of crisp greenbacks, fresh from the Treasury, which are to be promiscuously distributed. The auditor is immediately besieged. He stands in the midst of the eager-eyed villagers, registering benevolence and tenaciously holding on to the portfolio, less on account of the greenbacks than through the lack of them.

"The villagers announce that they all worked on chrome and that their wages are still due, and learn that the elusive portfolio must have been a twin to Mother Hubbard's cupboard. There is, however, one full-blooded Indian who stands at a distance, whom the auditor approaches, and the following dialogue ensues:

"Auditor—'Didn't you work on chrome, too?'

"Indian—(Characteristically devoid of expression) 'Sure.'

"Auditor—'Where?'

"Indian—'Top of mountain.'

"Auditor—'Did you get your money?'

"Indian—'No.'

"Auditor—'Well, don't you want it?'

"Indian—(Very emphatically) 'No, me work for Uncle Sam.'

"And that Indian had three sons who proudly wore red chevrons."

Excitement

One of the most sadly overworked words in newspaper mining parlance is "excitement." It has been used ever since gold was discovered at Sutter's Fort, and rarely with truth. A newspaper at hand tells of "excitement among engineers" over the good results that attended the sampling of a half ton of copper ore in preparation for installing a concentration process. Surely there was nothing in this for any engineer to get excited about. Other items tell of "excitement" over the striking of orebodies that do not appear to have had any *chispas* sticking out of the drift faces. In truth, the day has passed when bewhiskered miners shot holes in saloon roofs when one of their kind brought in his newest nugget. Rarely is there cause for much display of emotion in the deliberative, scientific mining practice that attains profit for the stockholders in these days.

Short Measure

"'Ere Jan, w'ot's the matter with e? Trim h'up tha back o' thy drif' a bit an' put in a couple o' 'ead poles. Firs' thing thee naws thee'll 'ave tha 'hol bloody roof daown on thee, an' there'll be singin' ta tha 'ouse an' thee'll not 'ear un. Sometimes I think you chaps don't naw any more than Billy Trewhella," says Cap'n Dick. "Billy an' 'is missus went to market, an' Billy, spyin' some h'oranges for sale h'asks tha shop-keeper for 'is prices. 'These small ones,' sez tha shop-keeper, 'comes one shillin' tha 'alf dozen, an' these 'ere big ones be two shillin.' 'Oh, gos along,' sez Billy. 'Give me tha small ones—there can't be many o' they big chaps go for to make h'up tha 'alf dozen.'"

The "Diamond Fields" of Arizona

"In 1872, the alleged discovery of diamond fields in Arizona created a great excitement throughout the nation," wrote H. H. Bancroft in his "History of Arizona and New Mexico." "Arnold and Slack were the discoverers. Splendid diamonds and rubies were exhibited in New York and San Francisco. Harpending, Lent, Roberts, Dodge, and other capitalists became sponsors for the great find. Henry Janin visited the fields as an expert, reporting them rich in diamonds. A company with a capital of ten millions was formed with such men as Latham, Selby, Ralston, Sloss, Barlow, and General McClellan as directors. A title to 3,000 acres was obtained; large sums were paid for interests in the scheme, and all was made ready, not only to work the claim, but to offer the stock to a credulous and excited public. Meanwhile, the papers were full of the matter, though there was less excitement in Arizona than elsewhere. A dozen parties visited the fields, some connected with the Harpending company and others not; and most of them, finding the spot without difficulty, brought back a variety of beautiful stones. All agreed that the place was in the region of Fort Defiance, some locating it across the line in New Mexico, but most in the extreme north of Apache County, near the junction of the Chelly and San Juan, where the inscription 'Diamond Fields' is to be seen on modern [written in 1889] maps. Arnold, however, said the spot was south of the Moqui towns near the Colorado Chiquito. Finally, Clarence King, United States geologist, visited the fields, and discovered the claim had been artfully 'salted' with rough diamonds from Africa, Brazil, and other parts of the world. Fortunately, the exposure came in time to prevent the swindling of the general public. Of the capitalists involved, who were victims and who culprits was never exactly known. The point of the whole matter, however, lies in the fact that, while, in all that was written, it was the 'Arizona diamond fields' that were described, and the 'Arizona diamond swindle' that was denounced, not only were there no diamonds in Arizona, but the salted claim was in northwestern Colorado, hundreds of miles from the Arizona line!"

CONSULTATION

Placer Oil Claims

"Will you inform me if the 'placer oil claims' located before the passage of the Leasing Act are to be under the Leasing Act? I am unable to obtain definite information in respect to the subject."

The important executive and legislative acts affecting title to and use of oil lands are arranged in chronological sequence in condensed form as follows: Prior to Sept. 27, 1909, oil lands under act of Feb. 11, 1897, could be located under placer laws subject to restrictions as to number of claims, national parks, and forest reserves. Title could be obtained by patent after proving discovery and complying with regulations of the General Land Office. Possession of placer claims not patented was maintained by performing assessment work.

After Sept. 27, 1909, an executive withdrawal order, known as "Temporary Petroleum Withdrawal No. 5," eliminated from "location, selection, filing, entry or disposal," under mineral or non-mineral land laws, "certain blocks of land." The order provided that all locations of claims existing and valid on this date may proceed to entry in the usual manner.

On June 25, 1910, the Oil Withdrawal Act gave the President authority to withdraw from entry or location public lands. In this act, the following provision occurs: " . . . provided, that the rights of any person who, at the date of any order of withdrawal heretofore or hereafter made is a bona fide occupant or claimant of oil- or gas-bearing lands, and who, at such date, is in diligent prosecution of work leading to discovery of oil or gas, shall not be affected or impaired by such order, so long as such occupant or claimant shall continue in diligent prosecution of said work; and provided further, that this act shall not be construed as a recognition, abridgment, or enlargement of any asserted rights or claims initiated upon any oil- or gas-bearing lands after any withdrawal of such lands made prior to the passage of this act."

On Feb. 25, 1920, the Leasing Act came into operation. Sec. 18 provides that on relinquishment to the United States, filed in the General Land Office within six months after approval of the act [limit date is Aug. 25, 1920], of all right, title, and interest claimed or possessed by claimant prior to July 3, 1910, and continuously held since by the claimant or his predecessor in interest, under existing placer mining law, to any oil- or gas-bearing land, upon which has been drilled one or more oil wells to discovery, embraced in executive order of withdrawal issued Sept. 27, 1909, and not within any naval petroleum reserve, and on payment as royalty to the United States of an amount equal to one-eighth value of production, claimant shall be entitled to lease not to exceed 3,200 acres, maximum, for a period of twenty years at a royalty not less than one-eighth of the production. For all like claims within any naval petroleum reserve, the producing wells thereon only shall be leased, together with an area of land sufficient for operation.

Sec. 18-a provides that the President is to direct the compromise and settlement, under such terms as may be agreed upon, of validity of any gas or petroleum placer claim under pre-existing law to land embraced in the executive order of withdrawal of Sept. 27, 1909, which has been drawn into question on behalf of the United States.

Sec. 19 provides that any person who on Oct. 1, 1919, was a bona fide occupant or claimant of oil or gas lands under a claim initiated while such lands were not withdrawn from entry, and who has complied with requirements for a valid location, except to make discovery, and upon which discovery has not been made prior to Feb. 25, 1920, and who has expended upon the claim $250 for each location, if application is made within six months (Aug. 25, 1920), shall be entitled to a prospecting permit on the same terms as provided for permits and leases. This does not apply to lands reserved for the Navy.

The foregoing, in our judgment, establishes the following status of existing oil placer claims:

Oil Placer Claims on Lands Not Withdrawn—All oil lands held under placer claims located prior to Oct. 1, 1919, and on which discovery has been made, can presumably be entered for patent. If no discovery has been made, then, unless application is made before Aug. 25, 1920, others presumably would have the right to apply for a prospecting permit.

Oil Placer Claims Within Limit of Withdrawn Areas—Bona fide claims on which discovery has been made, both claim and discovery made prior to Sept. 27, 1909, may be entered and patent obtained. If claim made before Sept. 27, 1909, but discovery made subsequently, the claimant under Leasing Act has right to lease of the land, if not on naval reserve, and of the wells, if on naval reserve. The protective clause given in the Oil Withdrawal Act would appear to us to give to all areas embraced within its provisions the right to patent if there had been diligent prosecution of work under a bona fide claim.

Beginning Feb. 25, 1920, areas embraced within known oil-containing geologic structures are to be leased to the highest bidder. On all other lands prospecting permits are to be issued. On discovery these permits give the discoverer the right to a lease.

In circular No. 672 of the General Land Office, on p. 26, the following statement occurs:

Stated negatively, under this section of the act [Sec. 37], the following classes of oil or gas placer locations, so called, notwithstanding absence of fraud and full compliance with law in other respects, may not proceed to patent, viz.:

(*a*) Any location made after withdrawal of the land.

(*b*) Any location made before withdrawal of the land but not perfected by discovery at date of withdrawal, which does not come within the protective proviso of Sec. 2 of the act of June 25, 1910 (36 Stat., 847); that is to say, any claimant who, at date of withdrawal, was not a bona fide occupant or claimant in diligent prosecution of work leading to discovery of oil or gas, and who has not continued in such diligent prosecution to discovery.

(*c*) Any location on lands not withdrawn, on which, at the date of the act, the claimant had not made discovery or was not in diligent prosecution of work leading to discovery, and does not continue such work with diligence to discovery.

THE PETROLEUM INDUSTRY

Oil-Field Water Problems.* Part II.

BY A. W. AMBROSE†

THE alkalies, sodium and potassium, are called primary bases; the alkaline earths, calcium and magnesium, secondary bases. The value of the strong acids with an equal value of the alkalies, or primary bases, induces the property of primary salinity. In connection with the alkaline earths they produce secondary salinity. Primary and secondary alkalinity are measured, respectively, by the excess of the alkalies or alkaline earth bases in excess of the values of the strong acids.

From the character formula already given of the water, Sample Q, Well No. 16, in Part I, the reaction properties of the solution are derived as follows:

Strong acids (5.3 + 1.7)	= 7.00		
Alkalies	= 7.00	Primary salinity	14.00
Alkaline earths (0.8 + 0.9)	= 1.70		
Weak acids	= 1.70	Secondary alkalinity	3.40
Alkalies (48.30 — 7.00)	= 41.30		
Weak acids (39.40 + 3.60 — 1.70)	= 41.30	Primary alkalinity	82.60
			100.00

In the study of waters it is often desirable to compare the values of different radicals in the character formula itself, and in the waters of the Coalinga field consideration of the relative values of the chlorides and sulphates in particular has thrown additional light on the relation of a water to its surroundings. Thus, in Sample Q the sulphate salinity is 5.3 and chloride salinity is 1.7; that is, the sulphate salinity is 76 per cent and chloride salinity is 24 per cent of the total salinity caused by the strong acids. These values alone suggest strongly that the water is a solution caused by mixture of a shallow water with another water of deep-seated origin.

With respect to their statigraphic position, the waters within the area of this survey may be designated as top, bottom, and intermediate waters.

Top Waters—Top or upper waters are either above the Big Blue shale or from 200 to 300 ft. below the top of the Big Blue. In these waters the values of the alkalies and of the sulphates generally predominate, resulting in high primary salinity and high sulphate salinity.

Analyses of two waters known to be top waters showed the properties given in Table V.

TABLE V. PROPERTIES OF TOP WATERS

	Properties of Reaction				Subordinate Properties	
	Primary Salinity	Secondary Salinity	Primary Alkalinity	Secondary Alkalinity	Chloride Salinity	Sulphate Salinity
Shell Co. Well 16-14	85	7	0	8	5	95
Record Co. Well 5	82	0	12	6	5	95

The source of the water of Well 16-14 is about 250 ft. below the top of the Big Blue and that of Record No. 5 is above the Big Blue.

Bottom Waters—Bottom waters are those coming from sands in the oil zone, and seem to emanate 600 ft. or more below the top of the Big Blue. A good sample of bottom water is in Well 16-14. Its properties are given in Table VI.

TABLE VI. PROPERTIES OF BOTTOM WATER

	Properties of Reaction			Subordinate Properties	
	Primary Salinity	Primary Alkalinity	Secondary Alkalinity	Chloride Salinity	Sulphate Salinity
Shell Co. Well 16-14	10	78	12	100	0

The source of the water is 728 to 840 ft. below the top of the Big Blue. The sulphates are completely reduced. It is characterized by high alkalinity, low primary salinity, and low sulphate salinity. Here the sulphate salinity is reduced to zero.

Intermediate Waters—Between the lower and bottom waters many so-called intermediate waters are found. Some of them tend toward upper waters and others toward lower waters in the distribution of their properties. The water in the Shell Co.'s Well 7-10 has properties characteristic of intermediate water and is given in Table VII.

TABLE VII. PROPERTIES OF INTERMEDIATE WATER

	Properties of Reaction			Subordinate Properties	
	Primary Salinity	Primary Alkalinity	Secondary Alkalinity	Chloride Salinity	Sulphate Salinity
Well 7-10	30	49	21	31	69

This water is 636 to 720 ft. below the top of the Big Blue. Such a water may be due to a mixture of top and bottom waters, or may be caused by partial reduction of the waters which come in contact with the oil.

In general the following ranges of properties is suspected:

TOP WATERS	
High primary salinity	(75–100)
High sulphate salinity	(90–100)
BOTTOM WATERS	
Low primary salinity	(0–15)
Low sulphate salinity	(0–10)

Properties whose values are intermediate between those of upper and lower waters are ascribed to intermediate waters. They are caused by the influence of the oil on lower waters, with consequent reduction of sulphates and increase in carbonates, and hence in low salinity. The upper waters are not in contact with the oil, so that the sulphates are not reduced, and hence there is high salinity.

Unless the chemical proportions of the inorganic constituents, and consequently of the reaction properties, of an oil-field water are permanent features of the solution, the application of the results of a water analysis is limited to the water at the time it was sampled for analysis. To learn whether or not the character of a deep-seated water is transitory and subject to change, two samples of the waters from the

*The second part of an excerpt from U. S. Bureau of Mines Bulletin No. 195, "Underground Conditions in Oil Fields," now in press. Published by permission of the Director of the Bureau.

†Superintendent Petroleum Experiment Station, Bartlesville, Okla., U. S. Bureau of Mines.

same bailer were sent at periods several weeks apart to a chemist for analysis. The chemist did not know that both samples were from the same source. The reports of the two analyses transposed into chemical values and terms are given in Table VIII.

TABLE VIII. INTERPRETATION OF A WATER ANALYSIS

A. Reacting Values in Per Cent

	Sodium	Calcium	Magnesium	Sulphate	Chloride	Carbonate
First sample...	49.1	0.3	0.6	2.7	16.7	30.6
Second sample	48.5	0.9	0.6	2.3	16.9	30.8

B. Properties of Reaction

	Primary Salinity	Primary Alkalinity	Secondary Alkalinity
First sample.....	38.8	59.4	1.8
Second sample.....	38.4	58.6	3.0

The close agreement of all the factors of quality of the two samples, as shown in A, Table VIII, and of the proportions of their reaction properties, as shown in B, leaves little cause to doubt the persistence of the chemical character of the water under examination, which, like nearly all the other waters considered, is distinctly a primary alkaline water, and the constancy of the chemical character of the water accords strictly with the permanence of the character of two deep-seated artesian waters from wells under Charleston, S. C. One of these wells is 1,200 ft. deep and the other is over 2,000 ft. deep. The waters in the two wells are from wholly different geologic horizons. For many years they have served the city of Charleston as a municipal water supply. From a careful investigation of those waters, Palmer[1] has found them to be of the primary alkaline type. He has established the fact that the proportions of their chemical properties are wholly different, and that they are from independent water courses. He has shown, also, that even after flowing for thirty-five years, each water remains unchanged in respect to its chemical character and mineral content. All the evidence thus far obtainable confirms the conclusion that the chemical properties of deep-seated primary alkaline waters are not subject to fickle changes, but are reliably constant.

To demonstrate the practical use of water analyses, a few examples of their application to production problems on individual wells are given. The analyses apply to waters occurring in the Coalinga field, California:

Example 1—The hole was open in a well, No. 8-10, 658-713 ft. below the top of the Big Blue shale, and at this depth the well had a water sand making 45 bbl. per day. Another well, No. 7-10, only 520 ft. distant, had found a water sand at 720 ft., only 7 ft. deeper stratigraphically than well No. 8-10. No. 7-10 water had a volume of 110 bbl. per day. This fact aroused the suspicion that the drill in No. 8-10 would strike another sand, only 7 ft. deeper, and that the water string should be landed at least 720 ft. below the marker.

Table IX shows the properties deduced from analyses made of waters in Wells 7-10 and 8-10:

TABLE IX. COMPARISON OF CHEMICAL PROPERTIES OF WELL WATERS

		—A. Properties of Reaction—				—B. Subordinate Properties—		
Well No.	Distance Below Top of Big Blue, Feet	Primary Alkalinity	Secondary Alkalinity	Primary Salinity	Total	Sulphate Salinity	Chloride Salinity	Volume, Bbl. per Day
7–10	615–683	12	22	66	100	92	8	20
	636–720	49	21	30	100	69	31	110
	700–720	70	17	13	100	53	47	90
8–10	658–713	35	18	47	100	86	14	45

The tabulation shows clearly that the proportions of the special properties of the waters in Well 7-10 change regularly with the depth of the well. (See Section A, Table IX.) For instance, the proportion of primary salinity—that is salinity caused by sulphates and chlorides of the alkalies—decreases progressively with the depth of the well. On the other hand, primary alkalinity advances steadily as the depth of the well increases.

A comparison of the waters was also made from a different aspect—the proportional chemical values of the sulphates and chlorides which together cause the saline quality of all of these waters. (See Section B,

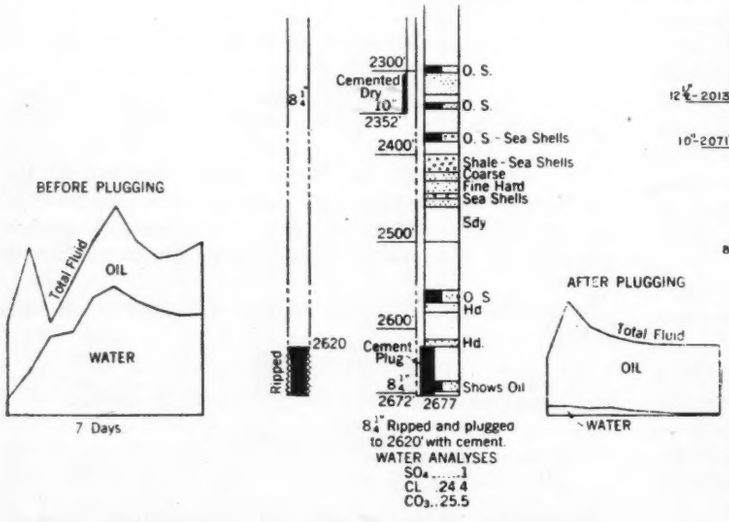


FIG. 1. SKETCH SHOWING PRODUCTION OF OIL WELL BEFORE AND AFTER PLUGGING OFF BOTTOM WATER. THE SOURCE OF THE WATER WAS DETERMINED BY CHEMICAL ANALYSIS. LEFT-HAND FIGURE SHOWS FLOW FOR ONE WEEK; RIGHT-HAND FIGURE FOR A SIMILAR PERIOD

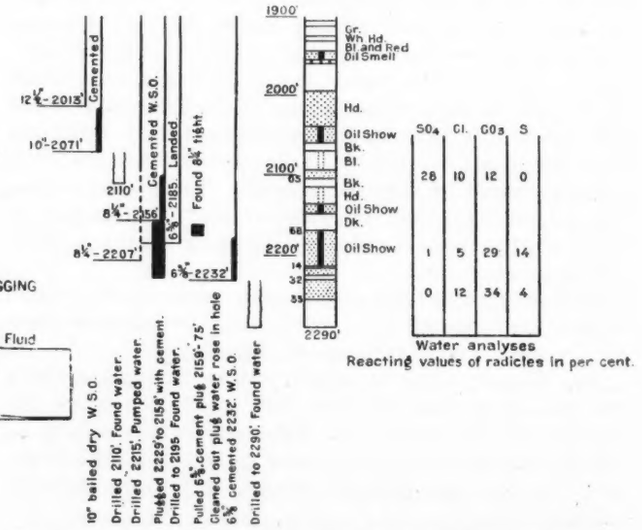


FIG. 2. GRAPHIC SKETCH SHOWING REACTING VALUES IN PER CENT OF RADICALS IN WATERS OF DIFFERENT SANDS AND CONDITION OF HOLE WHEN SAMPLES WERE COLLECTED. THE RESULTS OF THE ANALYSIS ARE RECORDED OPPOSITE SAND IN WHICH THE WATER WAS FOUND

[1]Palmer Chase, "A Deep Well at Charleston, South Carolina"; Professional Paper 90-H, U. S. Geological Survey, 1914, p. 90-94.

Table IX.) It will be observed that at 615 to 683 ft. the saline quality of the water is almost wholly due to sulphates, the chlorides contributing not more than 8 per cent of the total salinity of the well water at that depth. From the layer between 636 and 720 ft., the proportion of the sulphate salinity has been reduced to 69 per cent, and at 700 to 720 ft. it is still further reduced, so much so that the saline quality of the water is shared equally by sulphates and chlorides.

Interpreting the facts that sections A and B of Table IX disclose concerning the progressive changes in the proportions of the qualities of the waters with increasing depth of the water sands in Well 7-10, it appears that the water in Well 8-10 comes from a sand intermediate between the first and second water sands represented in the table. Stratigraphically considered, it is highly probable that its proper place is not at the bottom of the table, but should be directly under the first member. A vacant place in the table has, therefore, been left for its insertion as the second member of the series. It may also be inferred that the water sand in No. 8-10 did not extend to Well 7-10, but pinched out somewhere between the two wells.

This interpretation of the results of water analyses forewarned the company of the existence of the 90-bbl. water sand somewhere between 713 and 720 ft. below the top of the Big Blue. To obtain oil from a deeper sand in Well 8-10 it would be necessary to cement a string of pipe in this well at least 720 ft. below the top of the Big Blue. This necessity might easily have been overlooked if the quality of the waters in Well 7-10 had not been known. Furthermore, if Well 8-10 had not been cemented at least 720 ft. below the top of the Big Blue shale, the water string would have been landed above a water sand, thus making it necessary for the company to cement another string of pipe at an additional cost of several thousand dollars. It is reasonable to conclude that in this single instance the company considers the saving of labor, time, and money more than covered the cost of the few hundred dollars spent for an orderly chemical investigation of the quality of the waters in the sand formations.

Example 2—Another example of the practical application of water analyses of producing wells is shown by study of Fig. 1. This well was drilled to 2,677 ft. All the sands were perforated, and the well was put to pumping. The well produced for seven days, during which time it averaged 83 bbl. of oil and 104 bbl. of water per day. The production of water was a surprise, as it was the first time bottom water had been reported in this section. The water would have been much more with a larger pump, but the 2½-in. pump would not handle over 200 bbl. of fluid per day. Had it not been shut off, the water would have worked back into the oil sands and probably have done great damage.

A chemical analysis of the water showed it to be a bottom water, as the reacting value of the sulphate radical was 0.1 per cent, the chloride radical 24.4 per cent, and the carbonate radical 25.5 per cent. The bottom waters in this area were high in carbonates and chlorides and low in sulphates. The analysis thus indicated a decided bottom water. Accordingly, the extreme bottom sand was plugged off by ripping the casing and filling the hole with cement up to the base of the next sand (2,620 ft.). The cement was allowed to set for eight days and the well again put to producing. The well then made 80 bbl. of oil per day and 1 bbl. of water. In this case, the analysis indicated the source of the water without mechanical tests, and the repair work was done immediately.

Example 3—The following example (see Fig. 2) shows the use of water analyses in a well being drilled to test the different sands. The history of the work on this well is given in considerable detail to illustrate the care exercised in ascertaining the contents of each sand. The purpose of the tests was to discover a new oil sand that might have been overlooked in the drilling of other wells.

On the left-hand side of Fig. 2, the work on the well is shown graphically in progressive stages. This sketch shows the relationship between the depth of the hole and the possible source of the water at the time any sample was collected. The per cent of reacting values of the radical in different waters is shown at the right of the sketch, where they are recorded opposite the sand in which they occur. It is clear from these figures that the waters are distinctly different.

The 10-in. casing was cemented at 2,071 ft. The cement was allowed to set, and a pocket was drilled several feet below the casing shoe, after which the hole was bailed dry, and stood so for several hours, proving the water string was not leaking. This is indicated in the explanation on Fig. 2 by "W. S. O.," meaning water shut-off.

Drilling proceeded to a depth of 2,110 ft., and a bailing test was made to test out the sand at 2,095 to 2,105 ft. It was not possible to bail sulphur water below 1,340 ft. from the surface, thereby proving a large volume of water in the sand at 2,095 to 2,105 ft. A sample of water was taken for analysis, and it showed the following reacting values in per cent: SO_4, 28; Cl, 10; CO_3, 12; S, 0; which were characteristic of a top water in this field.

The well was deepened to 2,215 ft., and a pumping test was made after landing the 8¼-in. casing at 2,207 ft., with 119 ft. of shop-perforated pipe on the bottom. The well pumped 1,080 bbl. of sulphur water and no oil in four days.

It was next decided to shut off the water. The hole was deepened to 2,229 ft., in order to free the 8¼-in. casing, which was pulled and a cement plug put in from 2,229 to 2,158 ft., after which the 8¼-in. casing was landed at 2,156 ft. and cemented. After the cement had set, a pocket was drilled, and a bailing test was made on the 8¼-in. casing. The test was satisfactory and proved that the upper water had been shut off.

In an effort to test the sand 2,168 to 2,214 ft., the cement plug was drilled out to 2,195 ft., after which the 6⅝-in. casing was landed at 2,185 ft. and the well was bailed. The sand, the top of which was at 2,168 ft., showed an enormous quantity of water, an analysis giving the following reacting values in per cent: SO_4, 1; Cl, 5; CO_3, 29; S, 14. A glance at Fig. 2 will show that this water was entirely different from that in the sand at 2,095 to 2,105 ft.

The company expected oil production from the sand at 2,168 to 2,214 ft., and felt that possibly there was a leak in the 8¼-in. casing. The water analyses indicated a new water sand, but at this time the company was starting water analyses work, and so far chemical analyses had not demonstrated their reliability. To check the suspicion of water breaking around the 8¼-in. casing, it was decided to plug back up and test this string again. In the meantime sand heaved into the

hole. This was cleaned out to 2,175 ft., and a cement plug was put in between 2,175 ft. and 2,159 ft.; that is, the top of the plug was three feet below the bottom of the 8¼-in. casing. The well was again bailed dry, which proved that the water was not coming in around the 8¼-in. casing and that the indications of the water analyses of a new water in the sand at 2,168 to 2,214 ft. were correct. The plugging job could have been avoided if the company had used the results of water analyses.

The well, when 2,159 ft. deep, made about 24 bbl. of water per day, but when the hole was 2,175 ft. deep it was not possible to bail the water down. The well was cleaned out to 2,178 ft., and the water immediately rushed in. It could not be lowered over 200 ft. by hard bailing, again proving that the water was coming from the sand whose top was at 2,168 ft. The well was deepened to 2,235 ft. The 6⅝-in. casing was landed and cemented at 2,232 ft., in order to test out the sand whose top was at 2,232 ft. After the cement had set, a pocket was drilled four feet below the casing shoe and the well was bailed dry. It made practically no water when allowed to stand nineteen hours, thereby proving that the water was shut off by the 6⅝-in. casing. The well was deepened to 2,290 ft., and a bailing test was made on the sand at 2,232 to 2,255 ft. Part of this sand made approximately 200 bbl. of water in twenty-four hours. It was not at the extreme top of the sand, because the well was bailed dry after drilling to 2,236 ft. A sample was collected, whose analysis showed the following reacting values in per cent: So_4, 0; Cl, 12; CO_3, 34; S, 4. A glance at the percentage figures at the right hand side of Fig. 2 shows this water to be distinctly different from the two described before.

Additional work was done in completing the well, but its history is reviewed only to the point necessary to bring out the application of water analyses. The drillers reported oil showings in the sand at 2,168 to 2,214 ft., and, as a matter of fact, the sand produced nothing but sulphur water when bailed vigorously.

The Shell Co. of California, according to my knowledge, has used the results of water analyses in at least eighteen wells to indicate the source of the water coming into the wells. It is difficult to express the value of this work in dollars, but when the amount of oil that would have been lost if the water problem had not been solved is considered, it has meant thousands, if not hundreds of thousands, of dollars to that company. In operating expenses alone the use of the chemical analyses of waters has saved the company thousands of dollars, because, when any oil well starts to make water, a water analysis can be made, and this will indicate the source of the water. Repair work can start without the delay and expense of testing. When it is edge water, the company does not waste time making expensive tests for top and bottom water.

Application of Water Analyses in Gulf Coast Oil Fields

I understand that one of the large oil companies in the Gulf Coast oil fields has accomplished successful results by the use of chemical analyses of waters. An example of this work is given. A well that was perforated in two sands made water. A chemical analysis of the water showed it to be coming from the top sand. The top sand was shut off by means of a packer set on the tubing below the top perforations. The packer filled the annular space between the inside of the casing and the outside of the tubing. Following the setting of the packer, the well started flowing oil from the lower sand. This is but one of the several successful results accomplished in this particular work. Some of the wells came in flowing as high as 1,000 or more barrels of oil per day after corrective measures were taken, which had been suggested by the use of water analyses.

General Suggestions for the Use of Water Analyses

Collection of Samples of Water—A sample of water for analysis is of no value unless it is representative of the water found in the sand. The samples to be analysed should not be mixed with drilling water. A sample is of little value where several water-bearing sands are exposed in the hole. At the start of the work, the engineer should collect samples of unmixed waters from each sand, if possible, so that he may know the properties of the waters in definite water sands.

Where a producing well has made water for some time, an accurate sample may be obtained from the flow tank or sump, as other water has been flushed out. If the well has just started to make water, and other water has been in the tanks, it is best to take a sample from the lead line.

In drilling wells, the engineer should take every opportunity to get a true sample of water from a sand. This can often be accomplished by the collection of a sample from the first porous formation encountered by the drill below the casing shoe. If the first sand does not yield water, a sample can be collected in a lower horizon. All drilling water should be bailed out before the sample is taken, and a sample should be taken from the bailer after it has been run to the bottom.

How Water Analyses Are Used.—After a sample is collected and a chemical analysis made, the engineer should interpret the analysis according to Dr. Palmer's method. If there are several analyses, a tabulation should be made of the properties of the waters in known sands and of the distances of these sands from the marker. Then, when a well starts to make water, the source can be determined by comparison of the water's chemical properties with those in the tabulation. The use of water analyses is, therefore, a matter of comparison.

Each Field a Separate Problem.—The waters of each oil field are chemically different from those of another field. In Coalinga, Cal., I used both the properties of reaction and the character formula for comparing different waters.

Neal[8] reported that the content of solids in the top waters of the Augusta field (Kansas) averaged four or five times that in the bottom waters, and, in fact, so marked was the difference in specific gravity that Lewis[9] suggested that a hydrometer might be used to distinguish between these waters. Rogers[10] discussed the difference between Mid-Continent and California oil-field waters. The engineer will find certain distinguishing features in the chemical analyses of waters which will serve to identify the waters in one sand from those in another.

The character formula, as well as the properties of reaction, must often be considered in comparing different waters. This was brought out by my experience in

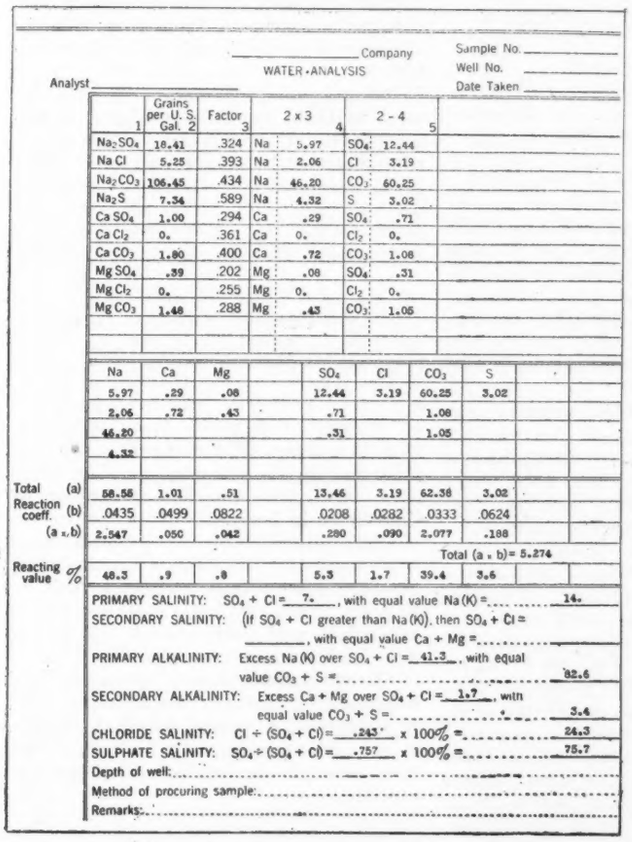
[8]Neal, R. O., "Petroleum Hydrology Applied to Mid-Continent Field"; Am. Inst. Min. Eng., Feb., 1919, p. 3-4.

[9]Lewis, J. O., chief petroleum technologist, Bureau of Mines.

[10]Rogers, G. Sherburne, "Discussion on Petroleum Hydrology Applied to Mid-Continent Field," by R. O. Neal; Am. Inst. Min. Eng., March, 1919.

Coalinga, Cal. The top waters were low in chlorides but high in sulphates. Thus, top waters would have a high primary salinity percentage. Bottom waters were practically free of sulphates but high in chlorides. The high chloride content gave bottom waters a high primary salinity. Hence, both top and bottom waters had a high primary salinity percentage, but a glance at the character formula readily told which was a top and which a bottom water.

Form for Computations.—The use of a chemical analysis of water necessitates its interpretation according to Palmer's method. This computation can be done



_____ Company
WATER-ANALYSIS
Analyst _____
Sample No. _____
Well No. _____
Date Taken _____

1	Grains per U. S. Gal. 2	Factor 3	2 x 3	4	2 - 4	5
Na_2SO_4	18.41	.324	Na	5.97	SO_4	12.44
Na Cl	5.25	.393	Na	2.06	Cl	3.19
Na_2CO_3	106.45	.434	Na	46.20	CO_3	60.25
Na_2S	7.34	.589	Na	4.32	S	3.02
Ca SO_4	1.00	.294	Ca	.29	SO_4	.71
Ca Cl_2	0.	.361	Ca	0.	Cl_2	0.
Ca CO_3	1.80	.400	Ca	.72	CO_3	1.08
Mg SO_4	.39	.202	Mg	.08	SO_4	.31
Mg Cl_2	0.	.255	Mg	0.	Cl_2	0.
Mg CO_3	1.48	.288	Mg	.43	CO_3	1.05

	Na	Ca	Mg		SO_4	Cl	CO_3	S		
	5.97	.29	.08		12.44	3.19	60.25	3.02		
	2.06	.72	.43		.71		1.08			
	46.20				.31		1.05			
	4.32									
Total (a)	58.55	1.01	.51		13.46	3.19	62.38	3.02		
Reaction coeff. (b)	.0435	.0499	.0822		.0208	.0282	.0333	.0624		
(a x b)	2.547	.050	.042		.280	.090	2.077	.188		
									Total (a x b)= 5.274	
Reacting value %	48.3	.9	.8		5.3	1.7	39.4	3.6		

PRIMARY SALINITY: $SO_4 + Cl$ = 7., with equal value Na (K) = ... 14.
SECONDARY SALINITY: (If $SO_4 + Cl$ greater than Na (K), then $SO_4 + Cl$ = _____, with equal value Ca + Mg = ...
PRIMARY ALKALINITY: Excess Na (K) over $SO_4 + Cl$ = 41.3, with equal value $CO_3 + S$ = ... 82.6
SECONDARY ALKALINITY: Excess Ca + Mg over $SO_4 + Cl$ = 1.7, with equal value $CO_3 + S$ = ... 3.4
CHLORIDE SALINITY: $Cl \div (SO_4 + Cl)$ = .243 x 100% = ... 24.3
SULPHATE SALINITY: $SO_4 \div (SO_4 + Cl)$ = .757 x 100% = ... 75.7
Depth of well: .....
Method of procuring sample: .....
Remarks: .....

FIG. 3. FORM FOR COMPUTING WATER ANALYSIS AS REPORTED BY THE ANALYST TO PALMER'S METHOD OF INTERPRETATION

more easily on a form after Fig. 3. A form can be drawn up, 8½ in. by 11 in., on which are printed the factors, formulas, and other data which are shown in Fig. 3. The figure represents the computations of an analysis. After the computations, the sheet can be filed for future reference.

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Oil Possibilities in San Diego County, Cal.

The region around San Diego, Cal., was recently examined by William S. W. Kew, of the U. S. Geological Survey, who is of opinion that San Diego County is not a favorable place in which to drill test wells for oil. The reasons for this opinion are: (1) The principal formations that furnish oil elsewhere in California are not found in San Diego County; (2) the Upper Cretaceous strata, which probably constitutes a large part of the sedimentary beds at San Diego, are not commercially productive in other parts of California, and there is nothing to indicate that they will be productive in the southern part of the state; (3) the Eocene strata, though of the same age as the oil-bearing strata in other parts of California, do not appear to contain oil here. As far as known, no structural features that are favorable to the accumulation of oil, such as anticlines, have been discovered in San Diego County. As the strata dip very gently, and at many places lie nearly flat, careful geologic work would be necessary to locate these structural features.

If drilling is continued near San Diego, the structure should be carefully studied to determine the most advantageous places for sinking wells to test the oil sands that are reported to have been penetrated in previous tests.

Current Bibliography of Petroleum and Allied Substances

A useful summary of recent articles on petroleum and allied substances has been compiled by E. H. Burroughs and appears as a part of the "Monthly Reports of Investigations" by the U. S. Bureau of Mines for March, 1920. The bibliography is classified under history; geology and origin; development and production; patents; transportation, storage, and distribution; properties and their determination; refining and refineries; utilization, legislation, and legal regulations; statistics; economics and nomenclature. A short descriptive paragraph is included under each article listed.

Barnes-King To Prospect for Oil

At a recent meeting of the directors of the Barnes-King Development Co., of Butte, Mont., the company's officials decided to embark in a moderate way in the oil-prospecting business and bought a number of shares of stock in an oil company operating in Fergus County, Mont. The result of the purchase will be to provide the oil company with sufficient funds to enable it to continue its present campaign of development.

NEWS FROM THE OIL FIELDS

The Peace River Field

Summary of Work and Results to Date in New Canadian Oil District

In response to many inquiries as to the oil situation in that field, the Peace River Oil and Development Committee reports as follows.

McArthur Well No. 1—Situated about ten miles down the river. Started operations in the fall of 1915. Oil was struck in 1916, and later a strong flow of water caused the well to be abandoned. McArthur Well No. 2—One mile up-stream from No. 1. A larger flow of oil was struck and gas to the extent of 1,500,000 cu.ft. per day. As much as 500 ft. of oil was in the casing of the well. The company decided to prove the field by going deeper, but encountered such a strong flow of water that the well had to be abandoned.

Tar Island Oil & Gas Co. Ltd.—Started operations in the spring of 1918 on opposite side of the river from McArthur No. 2, and struck oil in encouraging quantities, the oil being deposited in pools around the well. On going deeper, water was encountered, but was successfully shut off. At a depth of about 1,200 ft. the tools became stuck in the well and could not be extricated.

Among other wells in the course of being drilled are the following: The Albersas—Down 1,000 ft., and stated to have struck a good showing of oil. Work is being continued. Consolidated Oil Co.—Started a well and drilled down to 1,100 ft., when work was discontinued on account of difficulties with the drilling contractor. Community Oil Co.—Is in the field and has made a good start; work will be continued during the summer. Northern Pacific Co.—Has also made a good start and will continue during the summer; Williams Oil Co.—Now operating.

New Argentine-Chilean Petroleum Company

A new petroleum company has been organized in Santiago under the provisional title of the Compania Inicial de Petroleo de Mendoza, says Trade Commissioner Schurz in *Commerce Reports* of April 8, 1920. The capital stock of the company amounts to 300,000 Argentine pesos, about half of which is held by the president of the company, an Argentinian, and the remainder by Chileans. The field to be worked is located in the Province of Mendoza, near the boundary of Neuquen, about 120 miles from the Western Argentine Railway at Colonia Alvear. The oil found there is declared to be of much higher grade than that of Commodore Rivadavia; and if this proves to be the case, the capital stock will be increased.

Report of California Petroleum Corporation

The California Petroleum Corporation's report for 1919 presents the following summary of its own operations as well as its subsidiary companies:

	1919
Gross earnings	$4,621,654
Deduct:	
Operating expenses	1,492,943
Bond interest and minority proportion of earnings	104,583
Depreciation and depletion	776,866
Losses written off	719,617
Reserve for income and excess profits taxes	250,000
Net profit for year	$1,277,644

After making all of the above deductions this profit was equivalent to 10.53 per cent on the average outstanding preferred stock, as compared with 10.71 per cent in 1918. The gross earnings showed an increase of $467,300, but this gain was more than offset by the increase in the operating expenses and the losses charged off.

During the year the company expended on new wells on the various properties, $689,513. Expenditures have also been made for new tools, $106,080; power plants, $65,714, and other miscellaneous improvements, $59,154. There has also been expended $69,988 in the acquisition of new leases in prospective oil territory. Twenty-six new wells were completed and brought in during 1919 on the various properties, at a total cost of $674,970, or an average of $25,960 per well. The policy of charging the incidental drilling costs of the new wells to operating expense, as instituted in 1918, is still in operation, so that figures shown above applying to cost of new wells do not represent their actual total cost. The total net production of oil during 1919 was 3,343,449 bbl., of which 145,129 bbl. was produced from properties in the hands of the U. S. Receiver and 82,844 bbl. belonged to various lessors. Total producing wells were 190. Total sales amounted to 3,299,339 bbl., of a revenue producing value of $4,178,663.

Standard Oil of New Jersey Increases Preferred Stock

Plans have been consummated by the Standard Oil of New Jersey for an increase in authorized preferred stock from $100,000,000 to $200,000,000. According to W. C. Teagle, the president of the company: "The proceeds of the present issue will be used to acquire oil lands, to enlarge and improve refining and distributing facilities, to pay for tank steamers under construction, and to provide additional working capital. It is expected that the present issue of preferred stock will be sufficient, taken with surplus earnings, to provide the company with new capital for 1920 and 1921.

Texas Oil Fields

Home Oil Refining Co. Reported Sold—New Refinery on Neches River

The Home Oil Refining Co., which was placed in the hands of a receiver two months ago, has been sold to the Anglo-American Oil Co., of London, according to a report from Fort Worth. The sum involved is said to be $30,000,000.

The Magnolia Petroleum Co. is planning to build a second refinery on the Neches River, about three miles north of the present refinery and nine miles from Beaumont. A railroad spur has already been built to the site, and 700 acres are being cleared. The new plant will handle Mexican crude exclusively.

Anglo-Persian Oil Co. Builds New Refinery in Wales

The Anglo-Persian Oil Co. is erecting large refineries and storage tanks at Skewen, five miles from Swansea, with the object of making this the distributing center for the west of England, says the American Chamber of Commerce in London.

The crude oil will arrive at Swansea Port from the Persian oil ports in the company's own tank steamers, will be pumped direct from the steamer to the refineries, and thence back again for distribution after treatment.

The site chosen covers 400 acres, and hundreds of workers, cottages, a railway station, a model hospital, supply stores and canteens will be built. The total cost is estimated at £7,000,000 sterling.

Data Schedules for Oil and Gas Producers

A questionnaire, known as Form O, Treasury Department, Bureau of Internal Revenue, has just been issued. Instructions state that complete data as outlined in the form should be submitted by every oil and gas producer for each producing property. The questionnaire is divided into the following major divisions: Schedule I, cost of property as at date of acquisition; Schedule II, valuation of property for any purpose other than for discovery; Schedule III, revaluation on account of discovery; Schedule IV, land, well, and production data; Schedule V, depletion; Schedule VI, physical property; Schedule VII, sale of capital assets.

Operations on the oil properties of the Nipissing Mines Co. in Texas have been interrupted by a cyclone, which blew down the drilling apparatus at the second well, leaving the drilling tools in the hole. The first well is down 2,850 ft. at present.

THE MINING NEWS

A. H. Hubbell, News Editor

Diamonds in Arkansas

Discovered in 1906, 2,000 Gem Stones Have Been Found to Date—Owners Erecting Washing Plant and Prepared To Spend Quarter Million in Sampling Property on Large Scale

BY SAMUEL W. REYBURN AND STANLEY H. ZIMMERMAN
Written exclusively for *Engineering and Mining Journal*

THE diamonds found in Arkansas have their origin in a "pipe" of peridotite under geological conditions similar, as far as known, to those existing in the South African fields. The test proposed, for which the washing plant is being built, is to determine conclusively whether the stones are present in commercial quantity or are simply geological "freaks." Samuel W. Reyburn, president of the Arkansas Diamond Corporation, is prominent in business circles in Arkansas and New York City.—EDITOR.

In an occurrence of peridotite in Pike County, Ark., more than 2,000 diamonds have been found. This igneous rock, or "pipe," as it is called, is similar in its geological characteristics to such occurrences in South Africa. Control of the property has been acquired by the Arkansas Diamond Corporation of Virginia, with an authorized capital of $10,000,000. The company, under the supervision of its chief engineer, S. H. Zimmerman, has planned and is now installing on the site a mill capable of handling about 250 wet tons of peridotite a day to test the value of the property thoroughly.

The location as regards coal, fuel oil, lumber and other building materials and transportation is advantageous for mining operations. The available local labor supply is not trained for this kind of work, but the company has the good will of the community, and labor has shown a fine spirit in the work thus far accomplished.

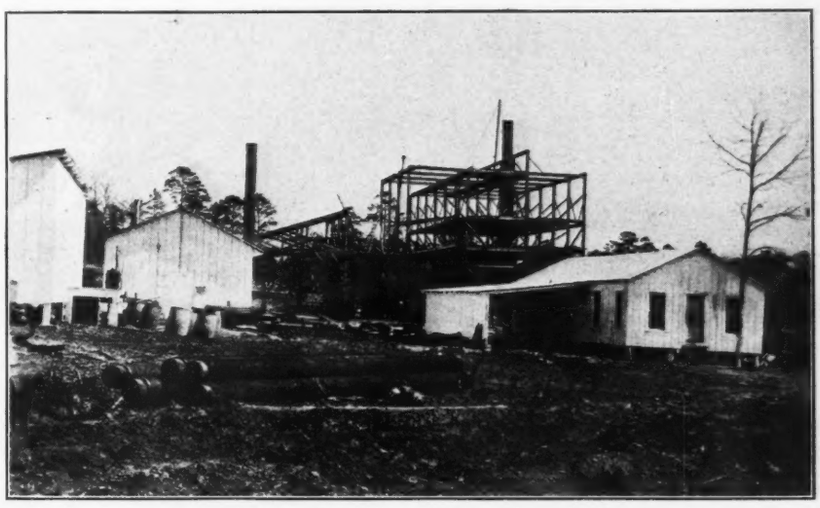
The diamonds that have been recovered average in weight a little less than half a carat, but the largest one weighed 18¾ carats. Many of the stones are of the finest quality. Of the few that have been cut, splendid results are shown.

Among those who have visited the area are: Dr. J. C. Branner, now of Leland Stanford University, who, as state geologist, surveyed and reported on it in 1890; Dr. Henry S. Washington, consulting geologist of New York, who reported on the property in 1907; Dr. George F. Kunz, of New York, a gem expert of international reputation, who visited the property at his own expense, and, as a result, wrote several papers; and John T. Fuller, a mining engineer, former manager of the Du Toit's Pan Mine, one of the properties of the De Beers Consolidated Mines, Ltd., of Kimberley, South Africa.

The company owns in fee about nine hundred acres. The actual diamond area covers approximately sixty acres. Titles have been passed by competent lawyers. The "pipe" is two and a half miles from the town of Murfreesboro, Ark., county seat of Pike County. It is 120 miles from Little Rock, the state capital and nearest large city. Fairly good roads, capable of taking a heavy traffic most of the year, run to Murfreesboro and thence to Norvelle, 8½ miles from the mine; to Delight, 16½ miles from the mine, and Cooley's Crossing, 9 miles from the mine. At each of these points, connection can be had with a branch line of the St. Louis, Iron Mountain & Southern R.R. The nearest point on the main line of this road is at Prescott, 95 miles from Little Rock.

Direct rail connection may also be had with the new Memphis, Paris & Gulf R.R., running from Nashville, Ark., to Murfreesboro, connecting with the main line of the Kansas City Southern at Ashdown, Ark., 40 miles southwest of Murfreesboro.

The highest point on the diamond property is 420 ft. above sea level. The country is rolling and wooded. The land, especially in the bottoms, is fertile, and the climate healthy.



WASHING PLANT OF 250 TONS' CAPACITY NOW UNDER CONSTRUCTION BY ARKANSAS DIAMOND CORPORATION FOR PURPOSE OF TESTING PROPERTY NEAR MURFREESBORO, ARK.

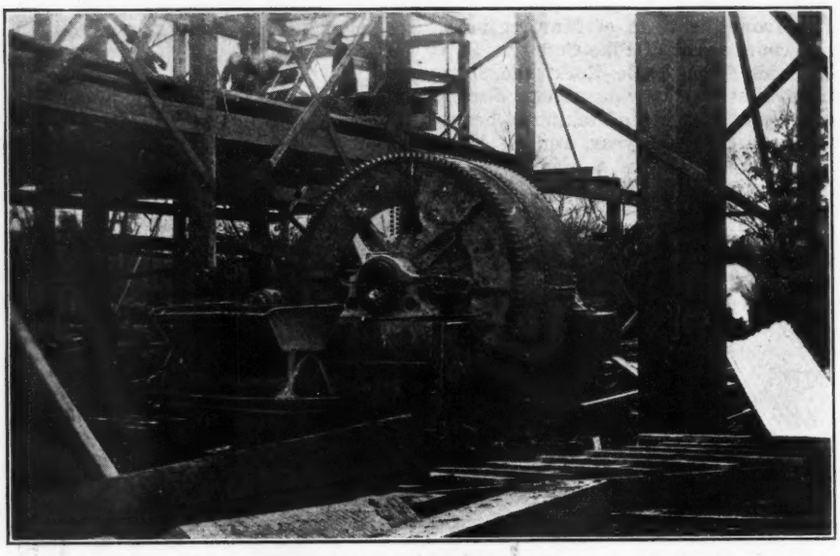
The occurrence of the igneous rock, later recognized as peridotite, at this point was first noted by a geologist by the name of Owen in 1842. To a layman, peridotite has somewhat the appearance of granite, but whereas granite has a high degree of resistance to the elements, peridotite generally is very susceptible and disintegrates quickly when exposed to the expansions and contractions of heat and cold with varying degrees of moisture.

It was not until about thirty-five years after this occurrence was noted that many scientists agreed that peridotite was the matrix of the diamond. In 1890 Dr. Branner visited the property and identified the rock as peridotite, but found no diamonds.

In August, 1906, John Huddleston, a farmer who had purchased the property several years before, found two small diamonds. He had them sent to Charles S. Stifft, a jeweler at Little Rock, Ark. Mr. Stifft associated with him A. D. Cohn, a merchant; Samuel W. Reyburn, a banker, both of Little Rock, and J. C. Pinnix, a lawyer of Murfreesboro, Ark. These gentlemen secured an option on the property and determined to try to develop a mine. They first called upon Dr. Kunz, who passed on the genuineness of the diamonds, but declined to take a retainer

and recommended Dr. Henry S. Washington as a geologist to pass upon the matter. Dr. Washington made several trips to the property and had considerable testing work done, during which time a large number of diamonds were found. On Oct. 30, 1907, he made a report showing it to be his conclusion that this occurrence of peridotite contained diamonds, and that they were probably there in paying quantities.

The original owners made several ineffectual efforts to get American capital to test and develop the property thoroughly. Their confidence in its future led them to expect capital to render its aid in return for a small interest. This, and the fact that American investors were inexperienced in testing diamond property, delayed development. In 1910, partners in a London banking firm visited the property and offered to finance it, but insisted upon the control of the project.



A HARDINGE MILL IS ALREADY INSTALLED AT PLANT OF ARKANSAS DIAMOND CORPORATION

In the summer of 1919 the owners succeeded in interesting a number of their friends, chiefly in New York, who have put up about $250,000. Engineers have planned and are now erecting a mill for the purpose of washing the decomposed peridotite and clay, of which there are two or three million tons overlying the surface of the "pipe," and thoroughly testing the peridotite in place.

Ratio of Concentration in Diamond Washing 14,500,000 to 1

To illustrate the efficiency with which a diamond-washing plant must be operated, a few statistics are offered, in which diamonds are compared with gold and copper. From this comparison it can be seen that there exists a vast difference between the visible results obtained in the treatment of these three elements.

One carat of diamonds weighs 200 milligrams; 2,270 carats weigh one pound avoirdupois and can be placed in a box two and one quarter inches square.

Diamonds amounting to 37,500 carats weigh about 16½ lb. or less than two quarts by volume. The rock or clay from which this small amount of stones would be extracted represents a volume that would fill 2,400 of the largest coal cars, or 48 trains of material.

The mills treating a 1 per cent copper ore are required to extract 20 lb. of copper from 2,000 lb. of rock, or 1 lb. in 100 lb. of rock. A mill treating a 1 oz. gold ore handles 24,000 lb. of rock for 1 lb. of gold. But a diamond-washing plant must treat 14,500,000 lb. to extract 1 lb. of diamonds (this, of course, varies with the richness of the ground).

As stated before, this area of igneous rock was known to geologists as far back as 1842, but the rock was not recognized as peridotite until about 1889, when it was reported on by J. C. Branner and R. H. Brackett[1]. Since then several have written on the geology of the occurrence. A few brief excerpts will suffice for the purpose of this article.

In this region the rocks are apparently all of sedimentary origin except the areas of peridotite, of which there are four exposures. The sediments belong to the Ordovician, Carboniferous, Cretaceous, and Quaternary periods, The formations of the area in which the peridotite occurs are the Trinity, of the Lower Cretaceous, and the Bingen sand of the Upper Cretaceous. The Trinity consists of beds of marly clay, sand, gravel, and limestone. The Bingen sand consists of intercalated beds of sand, clay, and gravel.

It is thought that the peridotite penetrated the Trinity formation, which has a slight dip south, and is younger than that formation. Considerable metamorphism of the clays from the Trinity has resulted in a semi-vitrified, reddish and grayish material, extending in many places several feet from the contact, the plane of which seems to dip at a high angle. There is no evidence of violence, due to the intrusion of the igneous rock, and it came, no doubt, as a simple and quiet flow.

As in most of the diamond "pipes" of South Africa, there is evidence of several intrusions in the same locality as shown by the dikes of peridotite traversing the principal area, which are of different color and texture from the main body. The whole exposed area is made up of different kinds of peridotite, varying from a thoroughly disintegrated soft and crumbly earth of green, blue, and yellowish-brown color to a dense, tough, dark-green, porphyritic rock called "hardebank," showing no evidence of weathering or alteration. Specimens of the latter show phenocrysts of olivine in a dense brownish ground mass, consisting of the usual minerals, such as augite, biotite, perofskite and magnetite crystals, together with a few small crystals of ilmenite and garnet.

Erosion is going on rapidly over the softer portions of the "pipe," and the run-off after each rainfall carries tons of the greenish-yellow mud toward the river. About 75 per cent of the "pipe" is covered by a mantle of sticky black residual clay derived from the underlying peridotite and vegetable matter and called "gumbo" locally, which varies from a few inches to several feet in thickness. Intermingled with the clay are large quantities of water-worn pebbles and fragments of conglomerate derived from the Bingen sand. Examination of this surface material indicates the possibility and probability of a concentration of diamonds, as it contains a concentration of the highly unalterable minerals derived from the peridotite.

The "pipe" is nearly circular in shape, having a diameter of roughly 1,800 ft. and an area of about sixty acres. Numerous test pits have been dug, and during the last fourteen years several thousand loads[2] of the surface clay and gravels, as well as the soft disintegrated rock, have been washed, from which many diamonds have been recovered. Owing to lack of proper facilities, none of the harder portions of the peridotite including the "hardebank" were tested. This "pipe," being similar in every respect to the "pipes" of South Africa, and having the different varieties of peridotite, will, no doubt, contain lean or barren portions with varying diamond content.

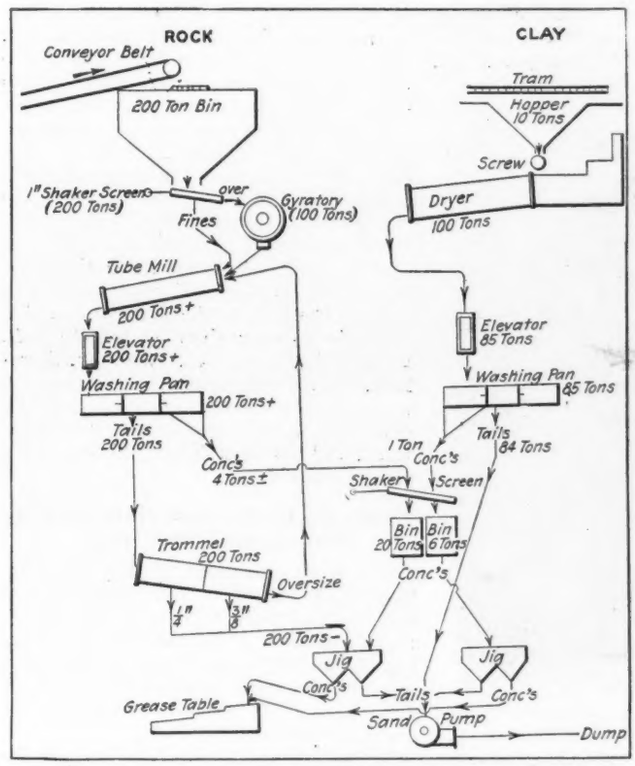
Testing a large area for diamond content is in many respects a difficult problem, which is not often encountered in sampling a metalliferous deposit. Taking, for example, a mine yielding 25 carats per hundred loads, or ¼ carat per load, it is seen that the value recovered after treatment is only a minute fraction of the material mined, being in fact but 50 mg. in weight. In other words, to illustrate more clearly, it may be stated that the poorest gold

[1] "The Peridotite of Pike County, Ark."; *Am. Jour. Sci.*, Vol. 38, 1889.

[2] The load is used in diamond mining instead of the ton and measures 16 cu.ft. and weighs approximately 1,600 lb.

ore treated on the Rand yields a product several hundred times greater by weight than the diamonds recovered from the lowest-grade diamond deposit profitably worked. The visible results, therefore, in the case of the diamond are not so certain unless a large tonnage be treated.

From the above it becomes evident that the sampling and testing must be done on a large scale, involving a large tonnage. To accomplish this it has been decided to excavate the rock from long radial trenches traversing the "pipe" in several directions and converging at a point close to the mill site. The depth of these trenches will vary with the topography, but will average 20 ft., and the width will depend on the depth and method of excavation. The broken rock will be removed, after a large portion of a trench has been blasted, by means of a heavy power scraper operating to a distance of 1,200 ft. from the "pipe" rim. Holes 5⅝ in. in diameter are being drilled by churn drill and blasted by 30 per cent ammonia dynamite fired by electricity.



FLOW SHEET OF NEW WASHING PLANT OF ARKANSAS DIAMOND CORPORATION

Test to Be Made Calls for Milling Approximately 120,000 Tons

Approximately 100,000 loads of the rock and 50,000 loads of clay will be milled, and, as there is practically no limit to the tonnage of rock available, the real test will be made upon the rock, and the future of the mine will depend upon the yield of diamonds from this source. The two materials to be treated are of an entirely different nature, one varying in character from a soft crumbly earth to a hard rock, requiring crushing, and the other being a sticky clay containing a large percentage of water-worn gravels. The accompanying flow sheet will make clear the two methods of treatment.

A mill is nearing completion which will be capable of handling 300 loads of material per nine-hour day. The mill site is flat and approximately on the contact or rim of the "pipe," thus enabling the power scraper to excavate and convey the broken material directly to the ore bin by means of an incline.

Method of Rock Treatment Outlined

As proposed in the accompanying flow sheet, the broken rock passes through a 6-in. grizzly at the top of a 200-load ore bin, which holds a day's storage. From the bin the material goes to a shaking screen from which the oversize passes to a No. 3 gyratory crusher crushing to 2½ in. or 3 in. The crushed rock together with the fines from the screen then goes to an 8-ft. Hardinge mill. With the exception of the "hardebank," all the rock will crush and grind itself mainly by attrition, thus releasing the diamonds from the rock particles. Fine grinding is, of course, not necessary, and as coarse a discharge as deemed advisable to release all the diamonds will be elevated to a standard 14-ft. washing pan.

The washing pan is of the usual type common to the South African fields and was designed and manufactured in this country especially for this mill. The radial arms carrying teeth set to a spiral revolve slowly, causing the teeth to stir the "puddle," down through which the diamonds and associated heavy minerals and crystals slowly settle while the slimes overflow near the center. As required, the concentrates are removed from time to time to be sized in trommels before being jigged. These concentrates amount to but 1 to 2 per cent of the original tonnage.

Careful sizing is essential to good jigging of diamonds, and especially constructed Harz jigs have been designed to do this latter work. The specific gravity of the diamond is about 3.54, and that of its associated minerals from 2.0 to 4.8. It is therefore impossible to make a clean separation of the diamond at this point and the minerals ranging from 3.25 to 4.8 together with the diamond form the hutch concentrates. These concentrates form from 15 to 20 per cent of the washing-pan concentrates or only 20 per cent of the original.

The final concentration of the diamond is effected on a specially designed grease table made in this country. The carefully sized concentrates from the jigs are fed to the grease table hopper and run automatically over the greased plates with a stream of water. This machine greatly simplifies the final separation, and stones as small as ninety to the carat may be recovered.

Unusual Method Devised to Extract Diamonds From "Gumbo"

The extraction of the diamond from the matrix of sticky tenacious clay containing a large percentage of gravels presented some difficulty, and it became necessary to devise a method rather unusual in ore-dressing practice.

Work carried on since the discovery of diamonds here proved it to be impossible by methods ordinarily used to disintegrate and break up the clay so thoroughly that all of the diamonds would be readily released. Any method of washing the naturally moist clay failed to break up all the lumps, and sticky round balls of clay carrying large pebbles always passed over into the tailings.

Recent experiments carried out on a large scale have shown that the clay, when thoroughly dried and then subjected to washing, absorbs moisture rapidly and swells to almost twice its original volume, till a critical point is reached. Beyond this point the lumps of clay slack to a thin mud similar to the action of lime when slacking. The charring and burning of the vegetable matter no doubt opens pores through which the water enters, thereby wetting the surfaces of the grains of sand and crystals to such an extent that the bond is broken and the thin mud or paste results. The diamonds and associated minerals readily settle to the bottom of the pan, and the concentrates from this point on are separately treated exactly the same as shown in the rock-treatment flow sheet. The process of drying will be accomplished by a 6 x 50-ft. direct-heat rotary drier, fired either by coal or wood.

Wood Fuel and Water Plentiful

An up-to-date steam power plant has been installed, consisting of a 250-hp. automatic Atlas engine, to which steam is supplied from two 150-hp. return tubular boilers at 125-lb. pressure. Fuel in the form of wood is plentiful on the property, although it is no cheaper than coal, owing to the present cost of labor.

Water from the Little Missouri River is supplied to a storage tank through a 1,200-ft. wooden pipe line of 6-in. diameter at the rate of 500 gal. per min. A combined fuel-oil pumping unit has

been installed in a water-tight pump house on the banks of the river. The Little Missouri is subject to floods, the water rising at times as much as 20 ft. in a few hours.

JOHN T. FULLER'S REPORT

Excerpts from the report made on the property by John T. Fuller are given as follows in closing:

"The diamond-bearing rock occurs in South Africa in what is there locally known as a 'pipe,' which is the neck, or vent, of an old volcano, filled up solid with diamond-bearing rock. This rock is technically known as peridotite, a rock of bluish-green color, and known in Africa as kimberlite, or more popularly as blue ground.

"That the diamond-bearing rock found on your property in Pike County is peridotite is unquestioned. That it occurs on the property in a 'pipe,' of sandstone, will soon crumble and fall to pieces. After weathering for a few months, which may vary from two to six, the disintegrated material can be easily pulverized, washed, concentrated, and the inclosed diamonds recovered.

"The harder varieties of the peridotite, which may and do occur in the same 'pipe' with the softer variety, and which are known as 'hardebank' present an entirely different problem. No amount of exposure to the atmosphere will have any practical effect on its disintegration. To be treated at all, it must first be crushed by powerful gyratory crushers and crushing rolls. The diamonds are then extracted in the same manner as from the atmospherically disintegrated peridotite. The economic and successful method of treatment of this 'hardebank,' which in hardness is equal to the hardest quartzites,

CENTRAL FIGURE IS STANLEY H. ZIMMERMAN, ENGINEER IN CHARGE OF CONSTRUCTION OF ARKANSAS DIAMOND CORPORATION'S WASHING PLANT

similar to its occurrences in South Africa has been, to my mind, sufficiently demonstrated.

"The use of the term 'blue ground' in connection with this rock is apt to be, and is, misleading. Many people are deceived by this term, and take it for granted that diamonds occur in a soft clay soil or ground, which presents no difficulty or great expense to wash and concentrate. This is distinctly not the case. This blue ground, or peridotite, as it will hereafter be termed in this report, varies considerably in hardness over different parts of the 'pipe.' In most cases the peridotite will disintegrate readily on a few months' exposure to the atmosphere and change to a dull grayish-green or yellowish-green color. The effect of this exposure to the variations of heat, cold, and moisture of the atmosphere is remarkable. Large lumps of peridotite, as big as the trunk of a man's body, and which, when deposited fresh from its original bed, has the hardness is still in a more or less experimental stage.

"The concentrate from this diamond-bearing peridotite contains many other minerals besides the diamond, among which may be mentioned mica, magnetite, olivine, and garnet. In no instance have the above-mentioned minerals or any other mineral, except the diamond, been found in the diamond-bearing peridotites of such quality as to have any commercial value. In other words, there is no commercial byproduct (as has often been extravagantly asserted) from the mining of diamonds.

"It is not within the scope of this report to go into the detailed description of the chemical or microscopical nature of this rock, nor is it necessary to discuss whether or not the eruption which brought it to the surface was violent, quiet, or otherwise. It is sufficient to say that the Arkansas peridotite resembles in every essential particular the diamond-bearing peridotites of South Africa and that the most essential commercial detail, the actual finding of diamonds within the mass, is fulfilled.

"The rock strata surrounding this Arkansas 'pipe,' as far as known at present, are quartzites and sandstones, with a more recent overlying coarse conglomerate. Judging from the experience with the African 'pipes,' to which, as I have said, this Arkansas occurrence has been demonstrated to be in every essential similar, this Arkansas 'pipe' containing the diamond-bearing rock will extend practically down to an unknown depth. It may or not be funnel shaped for the first one hundred feet or so. The chances are that it will be. This means that at one hundred feet or so in depth the area of the 'pipe' will be less than at the surface. However, a point will be reached where this contraction will cease, and the 'pipe' will then continue down in a fairly uniform manner to unknown depths. There may be a number of local expansions and contractions at various points, but in no case has it yet been known to contract sufficiently to seriously cause alarm as to the 'pinching out' of the deposit.

"To illustrate: The deepest mine at Kimberly is now down three thousand feet, with no exhaustion of deposit in sight. The area of the peridotite at this point is greater than at the 2,160-ft. level in the same mine. We may, therefore, with a large degree of confidence, expect to be limited in depth only by economic and engineering considerations, and not by a failure of continuity of the deposit."

Santa Fe Seeks New Rate on Zinc Ore and Concentrates

The traffic manager of the Atchison, Topeka & Santa Fe Ry. states that a petition has been filed with the Interstate Commerce Commission to inaugurate the following rates on ores and concentrates supplemented by a request for authority to publish these rates on one day's notice:

On	From	To	Rates per Ton of 2000 Lb.
Zinc ore and zinc concentrates, C.L. min. wt. given below	Hanover, N. M. Silver City, N.M. Fierro, N. M. Santa Rita, N.M. and intermediate points.	Canyon City, Col....	$4.50

The minimum weight will be the capacity of the car except where these companies are unable to furnish car of capacity ordered by shipper and, for their own convenience, provide a car of greater capacity. The charges will be computed on a basis of actual weight but not less than the capacity of the car as ordered by shipper.

Among the most interesting of the recent installations by A. Leschen & Sons Rope Co. is a tramway built for the Cia. Beneficiadora de Pachuca at Pachuca, Hgo., Mexico. This tramway is 4½ miles long and has a capacity of 100 tons of silver ore per hour. It is said that no tramway on this side of the Atlantic approaches this in combination of length and capacity.

Alvarado Mining & Milling Co. Planning for Greater Operations at Parral, in Chihuahua

New Equipment Being Installed and Experimental Work in Progress—Three Groups of Mines Operated by Company—Diamond Drilling at Portola, Cal., Under Same Management

Extensive experimental work in the roasting of ores is being conducted by the Alvarado Mining & Milling Co. at its plant in the Parral district of Chihuahua. A project is under way for doubling the capacity of this mill, which at present can handle 600 tons daily. Straight cyaniding is the process employed. A Dorr counter-current system is being installed, involving the use of three 40 x 20-ft. Dorr agitators. The size of thickeners to be used has not been determined. A 48-in. Symons disk crusher, to be placed at the head of the mill, is included in the new installation. Complete new transformer equipment is also to be installed, material for which is now on the way. The company uses hydro-electric power for all purposes.

CYANIDE PLANT OF ALVARADO MINING & MILLING CO., SITUATED ABOUT TWO MILES FROM PARRAL, CHIHUAHUA, MEX.

Three groups of mines are being operated by the company, the mines being connected with the mill by aërial tramways, one two miles long and the other two 3,000 ft. each. On Jan. 1 of this year the old Terrenates mine was purchased from the Terrenates Mining Co.

Considerable new mine equipment is being installed. This includes a 2,000-ft. Sullivan twin-angle compound compressor and two 12,500-lb. rope-pull, double-drum electric hoists capable of hoisting from 2,000-ft. depth. At present hoisting is being done from a maximum depth of 900 ft. Plans call for electric haulage both on surface and underground. A 1,500-ft. steam-driven Nordberg compressor is being converted to use electric power. The new hoists are to be supplied with 3½-ton skips equipped with Hyatt roller bearings and built on the three-point suspension principle. These are to be used in a 53-deg. inclined shaft.

Two large pumping stations using centrifugal pumps are also being installed at the mines. Each is a twin unit. The capacity of one is 800 gal. per min. and of the other two 2,000 gal. per min. An ore-washing plant is now being completed by the company.

The American Engineering & Operating Co., which is under the same management as the Alvarado company, has begun exploration of its property near Portola, Cal., where its ground immediately adjoins the Walker mine, operated by Anaconda. Diamond drilling under contract has already been started by the International Diamond Drill Contracting Co., of San Francisco.

Gold Producers Split Bonus

The operations of the Australian Gold Producers' Association for the half-year ended Dec. 31 last resulted in the directors being enabled to distribute a premium of 13s. per oz., amounting to £507,232.

Disagree Over Rates Charged for Handling Iron Ore

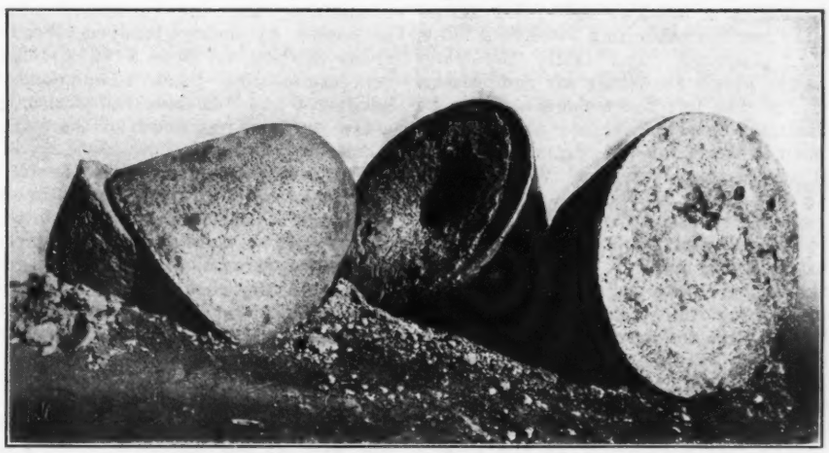
Dollar Per Ton Held Too Low by Lake Carriers — Association Would Raise Unloading Charge

Dissatisfaction is expressed by some vessel interests over the new rate of $1 a ton for carrying ore from the head of Lake Superior to Lake Erie ports. Some owners have held off and hope to get a higher price later on in the season, but most of the ore to be moved has already been covered by vessel contracts.

Mining interests have been stirred to action through the proposal of the Central Freight Association to increase the charge for unloading ore from the hold of a vessel to the railroads from 10 to 15c. per ton, and the charge for handling ore from the railroads to the dock from 6 to 8c. per ton. It is asserted that if the proposed increases go into effect it will be unjust to them as they have already made their sale contracts for this season. If to the 5c. increase for unloading be added 25c., representing the increased vessel freight rate, the 10 per cent increase in wages of mine labor, and the additional royalties imposed because of the increased selling price of the ore, operators claim little will be left to them from the $1 additional charged for ore this year.

Strike and Fire Lowered Output at Broken Hill in 1919

The output of the Broken Hill mines during 1919 was only 415,400 tons as compared with 1,251,161 tons in 1918. The reduction, of course, was due to the long strike, and as there has been no ore raised on the field since early in May last it can be imagined that the production during the present year will be below normal, especially as the South mine is engaged in the rebuilding of its mill. Largely owing to the Broken Hill position the mineral production of New South Wales for the past year shows a big drop, the value being £9,882,366 or £4,536,986 less than the previous year.



THE ALVARADO COMPANY FOUND IT CONVENIENT IN STRENUOUS TIMES TO SHIP ITS BULLION IN "BARS" CAST IN MELTING POTS AND WEIGHING 1,600 TO 2,000 LB. EACH

Oliver Iron Adding New Equipment to "G" Pabst Power House

Additions Projected Two Years Ago Now Being Completed—Plant at Ironwood on Gogebic Range

The Oliver Iron Mining Co. is gradually completing the installation of additions to the equipment of the power house at the "G" shaft of its Pabst mine at Ironwood, Mich., on the Gogebic Range. The "G" Pabst boiler and engine houses were built in 1909. The boiler house was 116 x 49 ft. inside, and contained eight 150-hp. return tubular boilers which were connected to a 150-ft. tile chimney. The engine house was 206 x 46 ft. inside, and contained the 28 x 60-in. duplex first-motion ore hoist, two tandem compound Corliss engines, 16 x 32 x 36 in., one of which was connected to a 300-kw. 250-v. d.c. generator and the other to a 300-kw. 2,300-v. a.c. generator, and lastly the compound steam two-stage air compressor. Space was left for a cage hoist to be installed later to replace an old hoist then in use in an old engine house. In 1916 the new cage hoist was installed in this place, as shown in the accompanying photographs.

In 1917 and 1918 the plant was enlarged. An addition, 51 x 49 ft., large enough for four boilers, was built on the boiler house, and three 400-hp. water-tube boilers with superheaters installed. Provision was made for the use of mechanical stokers and ash handling machinery, but that was not put in.

The fourth boiler is on the ground and will soon be erected, and the mechanical stokers will be put in during 1920. For these four boilers a 210-ft. concrete chimney was built (1917). In the engine house the two generator sets were removed and the two 5,000-kva turbo generators installed (1917-18). One of these the government had commandeered at the factory for use in France, but it was later released. These generators are the only load carried by the new battery of boilers. To take care of the electrical apparatus an addition, 70 x 15 ft. inside, had to be built on the north side of the engine house. In this, concrete compartments were built to carry the 2,400-v. bus bars, oil switches, breakers, and other equipment. The arrangement of these compartments, of the switchboard, and turbo sets can be seen in photo No. 2. The generators are cooled by air which is passed through a washer located in the basement. The turbines have jet condensers, and the condensed water is cooled by being pumped through spray nozzles set over a 76 x 168-ft. concrete cooling pond. The pond is between 6 and 7 ft. deep and is situated a few hundred feet south of the engine house.

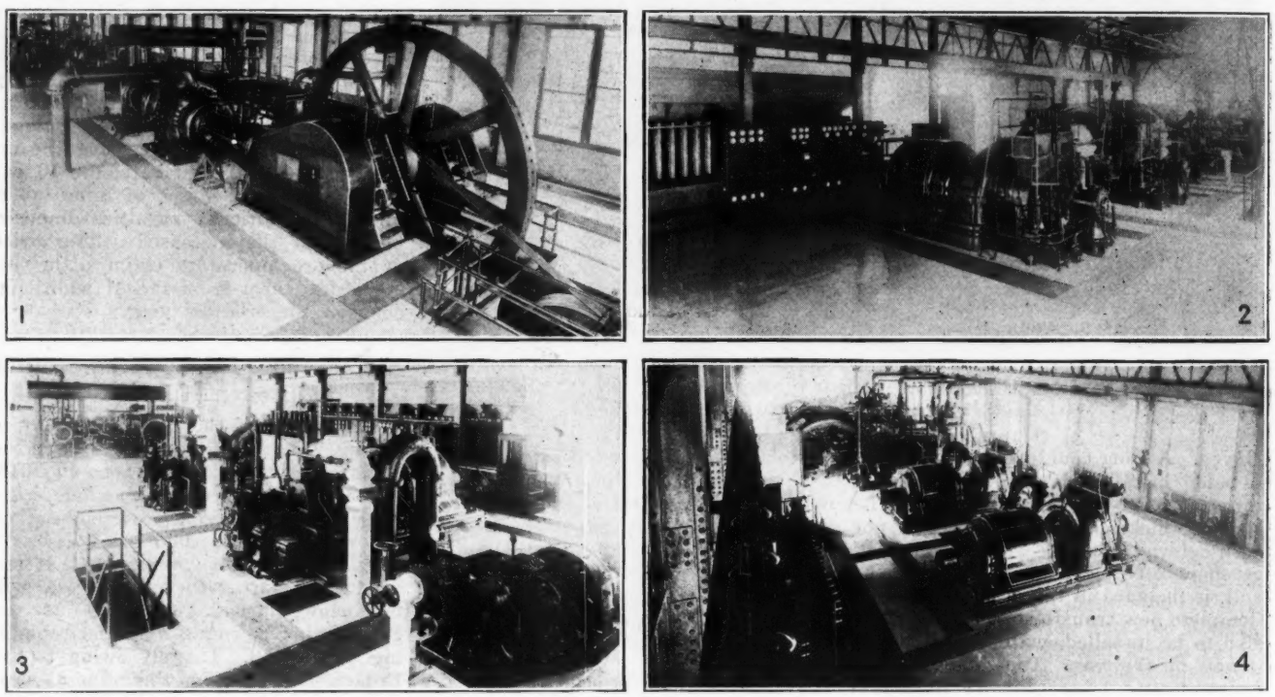
The present equipment is shown in the accompanying photographs which are described as follows:

No. 1 shows the 5,000-ft. compressor in the foreground, and the turbo-generators in the background. The compressor is 26 and 52 in. cross-compound steam and 28 and 45-m. two-stage air with a 48-in. stroke.

No. 2 shows the steam turbo-generator sets and switchboard. The generators are rated at 4,000 kw. at 80 per cent power factor, run at 3,600 r.p.m., and are three-phase, 60-cycle, 2,300-v. machines. They supply power for five ore hoists of 875 hp. each, five man hoists of 400 hp. each, two 2,275-ft. air compressors, two 150-hp. 300-gal. pumps, three 200-hp., 400-gal. pumps, and for surface and underground haulage, for shop motors, and other equipment. Two more air compressors and several mine pumps will be added to the load in 1920.

No. 3 shows the steam turbo-generators, with the air compressor in background.

No. 4 shows the steam turbo-generators and hoists. The ore hoist is in the end of the building. It is first motion, has two 28 x 60-in. engines and a 12-ft. drum with band brakes. It operates in balance and no clutches are used. The skips carry 7 tons of ore. The shaft is 64 deg. The cage hoist is second motion, has duplex 18 x 42-in. engines, herringbone gears, a 12 x 13½-ft. drum, and post brakes. It handles a single large cage. A counterbalance is to be installed at some time in the future.



EQUIPMENT OF "G" SHAFT POWER HOUSE AT OLIVER IRON MINING CO.'S PABST MINE AT IRONWOOD, MICH.
1. Compressor, with turbo-generators in background. 2. Steam turbo-generator sets and switchboard, latter showing concrete compartments for bus bars, oil switches and breakers. 3. Turbo-generators with compressor in background. 4. Turbo-generators with first motion ore hoist in background

Hopes Revive in Coeur d'Alenes for Pine Creek Railroad

Interest in the railroad up Pine Creek in the Coeur d'Alene district of northern Idaho is revived by the report that the Milwaukee Lumber Co. has taken over the partially constructed branch from the O.-W. R. & N. Co. and will extend it to tap a large body of timber on the west fork. This would bring the railroad to the Nabob mill, which has just started operation, and would be within four miles of the Douglas and Constitution properties, both of which are in position to ship lead-zinc ores with favorable transportation. The Constitution has a 100-ton mill.

Radium Ore Discovered in White Signal District, N. M.

A. A. Leach Finds Torbernite and Autunite on Grissom and Foster Claims—Also at Black Hawk

BY F. I. LEACH

Radium ore has been reported to occur in commercial quantities in the old White Signal mining district, in southern Grant County, N. M., eight miles south of the Phelps Dodge camp of Tyrone. The discovery was made by Albert A. Leach, chief geologist for the Phelps Dodge Corporation at Tyrone, but announcement of the find was withheld until recently when Mr. Leach began work on a group of 36 claims on which he had secured a bond and lease from Jack Grissom and Otto Forster, the original owners. The White Signal ores are torbernite, a copper-uranium-phosphate, and autunite, a calcium-uranium-phosphate.

The White Signal district was worked many years ago for gold, silver, copper and lead ores, but difficulties of transportation and a high smelting rate made it impossible to handle any but the richest ores. Gradually the district was abandoned and it has remained inactive, except for a few prospectors, for nearly twenty years. Although the claims of Grissom and Forster, which were worked for gold, lay almost at the roadside and attracted much attention, the uranium minerals were overlooked until found by Leach. Before Grissom came to White Signal some miner had opened up a fine showing of torbernite on what is now the Shamrock claim, owned by Grissom and Forster, and the same mineral was mined in considerable quantity at the Tullock mine and thrown over the dump as waste.

Thinking other districts in this section might have similarly neglected deposits of the radium ores, Leach visited and sampled both the ore and rocks of every camp within motoring distance of Tyrone and secured through prospectors and mining engineers samples from other camps in New Mexico and Arizona. The results of this search were not important except in the single instance of the camp of Black Hawk, lying 12 miles northwest of Tyrone, in the Bullard's Peak district, where pitchblende occurs disseminated through vein materials of the nickel-silver-cobalt type. All the old mines are inaccessible, and only dump materials have been investigated, except in the case of one shaft owned by the American Cobalt Corporation, where rich silver ore, carrying values in argentite and stromeyerite, was strongly radioactive.

The geology of the White Signal district has not been worked out in detail. The country rock is Pre-Cambrian granite intruded by dikes of dark felsite, a dense white felsite and monzonite porphyry. Oddly enough the monzonite porphyry, usually the dependable mineralizing agent in all the surrounding districts, is here apparently without any metalizing effect. The dark felsites are invariably closely associated with the uranium minerals, but not enough work has been done to state definitely what the relationships are, as practically all the work has been in search of other minerals and the uncovering of the uranium minerals was purely accidental.

There are two vein systems, one north-south and another nearly east-west. The dikes strike in all directions and have more or less vein action on one or both walls. The north-south veins are characterized by coarse white quartz with abundant and very slightly oxidized pyrite carrying very low gold-silver values. The east-west veins are narrow, thoroughly oxidized, and carry good values in gold and silver. In some places good values in copper, up to 16 per cent, and in bismuth ocher, up to 5 per cent, occur with the gold and silver and constitute the class of ore that has been the main shipping product from the camp. All the east-west veins yield gold on panning, but the gold is never visible as free gold in the ore.

The uranium minerals occur as torbernite and autunite, as stated, at or near the contacts of the east-west veins with the dark felsite dikes, and are in every instance noted disseminated in much fractured and altered dark felsite, forming incrustations and foliate micaceous aggregates. The torbernite is a bright emerald green with pearly luster. The autunite forms tabular crystals of a bright yellow color in irregular groups.

The principal development is on the Merry Widow claim, where a shaft has been sunk on an east-west gold vein to a depth of 120 ft. A dark felsite dike parallels this vein and is exposed the full depth of the shaft. It is from 6 to 20 in. wide and carries a fairly uniform value of ¾ to 1 per cent U_3O_8 as mined. Selected pieces give 5 per cent U_3O_8, and a considerable amount of the vein would give an easily sorted product of 2½ to 3 per cent U_3O_8.

The Acme claim lies close to the Merry Widow claim and has three openings over a distance of about 300 ft. The deepest work is barely 16 ft. Every opening shows autunite and torbernite. This vein has a north-south strike but differs from the general north-south veins and is more like the east-west veins in appearance. This vein is also paralleled by a dark felsite dike. The autunite occurs in both the vein and dike but is richer in the dike. Some turquoise forms near the surface, but is not of gem grade. On the whole the values are somewhat lower than in the Merry Widow.

A shallow hole on the Shamrock claim shows a very good grade of torbernite almost from the grass roots. This showing is located on the intersection of an east-west gold vein and a dark felsite dike, with the torbernite again favoring the felsite.

At the Tullock mine, about a mile and a half from the Merry Widow shaft along the same mineral belt, a shaft was sunk to a depth of about 200 ft. on an east-west vein carrying copper carbonates in a coarse quartz gangue. The vein stuff does not show the uranium minerals, but a dark felsite dike which crosses the vein near the shaft was crosscut at considerable depth and shows torbernite lining vugs and as incrustations on fracture faces. The grade is one-fourth to one-half per cent U_3O_8, but, as this is only waste thrown over the dump, and no effort was made to mine uranium ore, these samples cannot be taken as representative. Further east along the felsite dike torbernite is found in small micaceous aggregates on fracture faces in the dump materials at a 20-ft. caved shaft about 20 ft. from the intersection of another copper-quartz vein with the dike.

It is too early to predict what the future of the district will be, but there is ore in sight at this writing to warrant exploration on a large scale.

Laloki Copper Mines in Papua Will Erect Smelter

Papua, formerly British New Guinea, which is under the control of the Commonwealth of Australia, will shortly become a copper producer. The Laloki Copper Mines comprise two properties, the Laloki and Dubuna mines, on which 350,000 tons of 4.8 per cent copper has been developed. The mines are situated 14 and 17 miles respectively from Bootless Inlet, and a narrow-gage railroad is to be constructed between the mines and the port. Analyses of ores from both mines prove them to be of true pyritic type of unusually high grade. A smelting plant with a capacity of 6,000-7,500 tons of ore per month is to be erected immediately. It is expected that the railway and smelter will be running by the end of the year. According to estimate blister copper can be produced at a cost of £45 per ton f.o.b. Bootless Inlet.

Wage Scale at Bingham Canyon, Utah, Raised 25 Cents

A wage increase of 25c. per shift became effective at all mines in Bingham Canyon, Utah, on April 1. With this the scale of wages paid all mine, mill and smelter men at these properties became equal to that in force in other camps in the state. Machine men under the new scale receive $5.25, helpers $5, miners $5, muckers $4.75, timbermen $5.25 and laborers $4.

Arctic Iron Co.'s Petition Denied by Supreme Court

The petition for a writ of certiorari made to the U. S. Circuit Court of Appeals for the Sixth Circuit by the Arctic Iron Co. against the Cleveland-Cliffs Iron Co. and others has been denied in the U. S. Supreme Court, thus affirming the judgment of the Circuit Court of Appeals in favor of the defendant. The Arctic Iron Co. was represented by Otto C. Sommerich and Edwin M. Borchard. A. C. Duskin, Horace Andrews, and W. P. Belden were counsel for the Cleveland-Cliffs company.

New Mill of Iron Cap Copper Co. Nearing Completion

Construction Has Been Supervised by David Cole, Designer—Rod Mills Will Be Used

The new mill of the Iron Cap Copper Co., which is situated at Copper Hill, near Globe, Ariz., is nearing completion. It was designed and is being built by David Cole, consulting engineer of El Paso, Tex. The initial capacity will be 300 tons per day. With the addition of one 5 x 10 C-B rod mill, one model-C duplex Dorr classifier, and three Deister Plat-o tables, for which provision has been made, the capacity of the mill can be increased to 500 tons per day.

The ore will be crushed to minus ⅜ in. at the Iron Cap shaft by means of one 7½ gyratory crusher, followed by one 48-in. Symons disk crusher. The crushed ore will be transported approximately 3,500 ft. to the mill over the company's new electrically operated 24-in. gage railroad in side-dump cars of 125 cu.ft. capacity.

The mill ore bin is of 750 tons' capacity. The ore will be drawn from this bin with six pulley-type feeders and conveyed by incline conveyors, one of which is equipped with a Merrick weightometer, to a 5 x 10 C-B rod mill where it will be crushed to approximately 12 mesh. This product will then be equally distributed to four Deister Plat-o roughing tables, where finished coarse concentrates will be made.

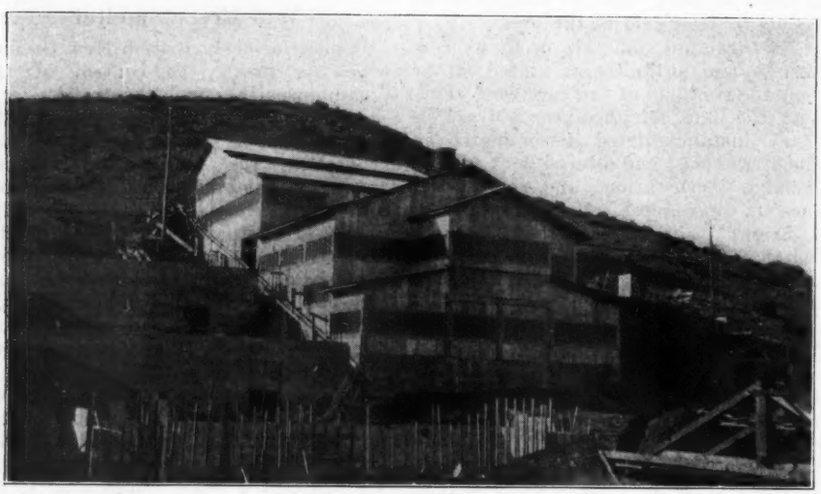
The tailings from the roughing tables will be re-ground to minus 48 mesh in one 5 x 10 C-B rod mill operated in close circuit with one model-C duplex Dorr classifier. This material will then flow to one double eight-compartment Inspiration-type roughing machine of concrete construction. The concentrates from this machine will be re-treated in one double four-compartment cleaner machine, of the same design, where a finished flotation concentrate will be made.

The tailings from the cleaner machine will be returned to the head of the rougher machine. The rougher tails will be deslimed with two drag belts, and the resulting sands re-treated on six Deister Plat-o tables where finished concentrates will be made that will be combined with the flotation concentrates and prepared for shipment to the smelter in Dorr thickeners and Oliver filters.

The slime overflow from the drag belts will be combined with the fine table tails and will flow to one 50-ft. Dorr thickener for reclaiming water. The final tailings will be flumed to the tailings disposal site, which is a natural basin and ideal for that purpose.

Water for mill use will be pumped from the Iron Cap shaft with a 300-gal. per min. Aldrich vertical quintuplex electrically-driven pump. This water, together with the reclaimed water, will be pumped to the main supply tank above the mill.

All mill equipment is modern in every respect. Electric power for all operations is obtained from the Inspiration Consolidated Copper Co. over the Iron Cap Copper Co., transmission line.



NEW MILL OF IRON CAP COPPER CO., AT COPPER HILL, NEAR GLOBE, ARIZ., NOW NEARING COMPLETION. INITIAL CAPACITY IS 300 TONS

Replogle Steel Co. Remodeling Blast Furnaces

The Replogle Steel Co., after spending a large sum in remodeling its blast furnaces, expects to have the first of them in commission about midsummer and the second a little later. With these in operation the company will have a capacity of over 300,000 tons of iron per year, which will probably be increased.

According to the management, the company will be able to produce concentrates better than 60 per cent in grade at a cost low enough to facilitate competing with Lake ores. Work on ore concentration has passed the experimental stage. The facilities for this work are to be greatly increased. The company recently took over the plant and assets of the Wharton Steel Co. at Wharton, N. J.

Lead Industry of France Undergoing Expansion

Peñarroya Company, Leading French Producer, May Make Country Independent of Outside Sources

BY RICHARD H. VAIL

France is apparently approaching the day when her lead works will meet the nation's requirements for that metal. This report was recently given by M. Paraf before the Congress of Civil Engineers, though *Echo des Mines*[1] makes the comment that there was little change in the lead industry of France during the war and that the new production planned has not yet begun to be an important factor in the present market. While the contemplated extensions of existing and new works may result later in the production of the country's requirements of lead, the ore is not all mined in France; Spain, Algeria and Tunis at present furnish most of the extraneous supply.

The Pontgibaud Company still supplies half of the national production from its Coueron works. But the Peñarroya company is certainly to be the leading French producer with its four works of Megrine in Tunis, Estaque, near Marseilles, the Pyrenees works and finally Noyelles Godault.

Peñarroya's Megrine works, according to *Echo des Mines*, can produce 20,000 *tonnes* from Tunisian ores; Estaque about double, though it has not yet begun operation. The same is true of the Pyrenees works where local ores will be treated (zinc to be recovered by the electrolytic method similar to that employed in the United States by the Anaconda company). As for the Noyelles Godault works, this plant formerly belonged to the Société des Mines de Malfidano, which has lately transferred it to the Peñarroya company. The Noyelles Godault plant was destroyed by the Germans and the Malfidano company took this occasion to liquidate a business which, from its special point of view as a Sardinian mining company, was always a doubtful enterprise and never brought the results that had been forecast for it. Feñarroya proposes to reconstruct this plant on a new plan which contemplates an important increase in its productive capacity.

Besides the works above enumerated, there are those of Langeac, now idle, and of Ceilhes in Hérault where the Orb company makes a little antimonial lead. The Escalette works at Marseilles has lately been purchased by the Grammont company, which is desilverizing Spanish and Grecian lead. The Cie. des Métaux has purchased the Saint Louis lead plant at Marseilles where it treats Spanish crude lead.

M. Guillet estimates that the normal post-war consumption of France can hardly exceed the pre-war figure of 120,000 *tonnes* per annum. If, as now estimated, the production of new works attains 90,000 *tonnes*, there would be with the pre-war production (30,000

[1] *Echo des Mines*, Feb. 15. 1920.

tonnes) 120,000 *tonnes* available which would meet the requirements of the nation. . . . If Peñarroya succeeds thus in making France independent of outside sources of lead, the company will have rendered France a great service.

Michigan Smelting Co. Making Insecticide from Arsenical Copper

Arsenical copper is mined in two shafts of the Ahmeek mine and in two of the Mohawk. For years it presented a problem in smelting and marketing. Under stress of finding a market for the arsenic, which was removed by smelting, experiments were conducted which brought about a limited use of the arsenic for making insecticides. Arsenic combined with lime makes tricalcium arsenate paste (arsenate of lime). As an insecticide it is particularly useful with stone-fruits, as it does no harm to the leaves. The Michigan Smelting Co. produced 70,000 lb. last year and will produce 80,000 lb. this year. A peculiar situation arises, however. Just at the time when a market for the arsenic is found the relative importance of copper carrying a trace of arsenic changes. Now arsenic copper demands a premium.

National Mine at Mullan, Idaho, Closes Down Again

The National mine, near Mullan, Ida., closed down on April 8, and it is believed that this action marks the end of prolonged efforts to place the property on a paying basis. Operations suspended last summer, following which the directors announced in a report to the stockholders that the mill and all equipment would be disposed of to the best advantage and the property abandoned. This action was met by a vigorous protest from many stockholders, who insisted that further exploratory work should be done since the company had over $50,000 in the treasury. Yielding to the demands of the stockholders, the management resumed work about Feb. 1, driving two crosscuts north in the hope that a new orebody would be met. Failing to find ore or substantial encouragement after extending each crosscut about 300 ft., work was discontinued and it is expected that the original purpose of the directors will now be carried out. The company has a modern 600-ton concentrator, an electric tram a mile and a half long, a compressor, a tool sharpening outfit, a hoist, and, in general, complete equipment for operation on a large scale. The ore is copper associated with silver, but too low in grade to permit profitable operation.

Stockholders of the Shannon Copper Co. at the recent annual meeting voted 154,295 shares in favor to 100 shares against to authorize the directors to invest at their discretion any portion of the $431,000 net current assets of the company in the purchase and operation of oil land leases.

Queensland Producing Arsenic at State-Owned Mine

Entire Output Used for Destroying Prickly Pear—Mines Department Will Enlarge Plant

The Mines Department of Queensland, Australia, is operating a government-owned arsenic mine at Jibbinbar, near Stanthorpe, in the southeastern corner of the state. According to a recent issue of the *Queensland Government Mining Journal*, "The mine is now yielding arsenic from the lower-grade ore, which, on being put through the furnaces, has averaged 11 per cent arsenic, and which during the last ten days of January produced something like 28 tons. Hitherto the consumption of arsenic has, owing to the high price ruling for the product, been less than 60 tons per month, but the minister anticipates that constantly increasing quantities will be used in Queensland if the price can be kept down to £20 per ton, and that the demand for the commodity, particularly for prickly-pear destruction, for which purpose it is being supplied by the Government at £10 per ton, will become very great.

"As showing what benefit a cheap supply of arsenic must prove to the state for destroying the prickly-pear pest, and consequently in checking its spread, it is interesting to note a statement recently made before the Public Works Commission by the Under Secretary for Lands in connection with the proposed Northern Burnett railway. Mr. Graham said that in the Callide Valley there had been classified as suitable for close settlement about 1,000,000 acres, which, with railway communication, would be worth £2,000,000, or an average of £2 per acre. Pear had made its appearance in the scrubs on this area, and, on a conservative estimate, it would now cost £10 for every £1 it would have cost in 1915 to clear it.

"The orebody at the state arsenic mine is very large. At the 209-ft. level it has increased in width from 5 ft to 12 ft. at the bottom, where the average value is 22 per cent. . . . The whole of the arsenic produced has been distributed. The Mines Department proposes to add to its plant at the mine and hopes thereby to be able to supply all requirements."

B. C. Allied Forces Exemption Act Amended To Cover Placer Claims

The "Allied Forces Exemption Act" of British Columbia has been amended at the present session of the Provincial Legislature in order that its provisions may continue in force until 1921. It also is made to apply to placer claims, whether held by record or lease under the Placer Mining Act. This simply means that returned soldiers who held mineral or placer properties in British Columbia at the time of their enlistment are given a further period to get on their feet before the obligations set out in the Mineral and the Placer Acts are applied to them.

Coeur d'Alene Syndicate Takes Option on Control of Flynn Group Mining Co.

Property Regarded as Promising—Syndicate Organized by Seely W. Mudd and Phillip Wiseman

The Coeur d'Alene Syndicate has taken over the option on the control of the Flynn Group Mining Co. which was secured by Rush J. White, mining engineer of Wallace, acting as agent. The option on control of the Flynn carries with it an option on the control of the Black Bear Mines Co. also, this option having been held by the Flynn Group company. The two properties join, the chief development work having been done on the Black Bear, which forms the key to the development of the Flynn. Considerable lead-silver and zinc ore has been exposed in the Black Bear and further development is in progress. The main tunnel is being extended on the vein to explore the Flynn ground.

The Flynn Group is on the high divide between Canyon Creek and the South Fork of the Coeur d'Alene River, adjoining the Black Bear on the west and the Star on the east, the latter being the property involved in the apex litigation with the Federal company, decision of which is now pending in the U. S. Court of Appeals. Owing to its location between two of the most productive sections of the district, the Flynn Group has long been regarded as one of the most promising undeveloped properties in the Coeur d'Alenes.

The Coeur d'Alene Syndicate, which holds the options on the Flynn and Black Bear, was organized by Colonel Seely W. Mudd and Phillip Wiseman, of Los Angeles, through representations made by Rush J. White, who is directing the development as agent of the syndicate, in which he also has an interest. Horace V. Winchell, the noted geologist and engineer, is also interested in the organization. The syndicate includes some of the most noted and successful operators in the west, also an English exploration company, the names of which are for the present withheld.

Wages Raised at Leadville, Col.

Mining companies in the Leadville district, in Colorado, announced a voluntary increase in wages to miners on April 9, which is effective as from April 1. The minimum wage is now $4.50. The advance makes the Leadville scale equal to that in effect in practically all of the mining camps of the state, except Cripple Creek, which being a strictly gold camp, has a schedule 50c. below that.

An amendment has been passed to the Iron Ore Bounties Act of British Columbia extending the period of its operation to 1925. This legislation empowers the Provincial Government to pay a bounty of $3 a ton on pig iron manufactured in British Columbia from local ore, and $1.50 a ton on pig iron produced from ore produced outside.

One Big Union Gaining Strength in Ontario

Recent Election of Radical in Temiskaming District Has Given Impetus to Movement

The One Big Union is making strong efforts to establish itself in Northern Ontario, and is meeting with a fair degree of success. Its efforts have been strong in the lumber camps, and particularly along the north shore of Lake Huron and Lake Superior it has been able to create minor disturbances. Organizers are busy in Cobalt, Porcupine and Kirkland Lake, and while the number of men enrolled is small in proportion to the number of men employed, the O. B. U. has succeeded in rounding up the radicals and disaffected men and it is this active minority that is usually responsible for the trouble in the older organizations.

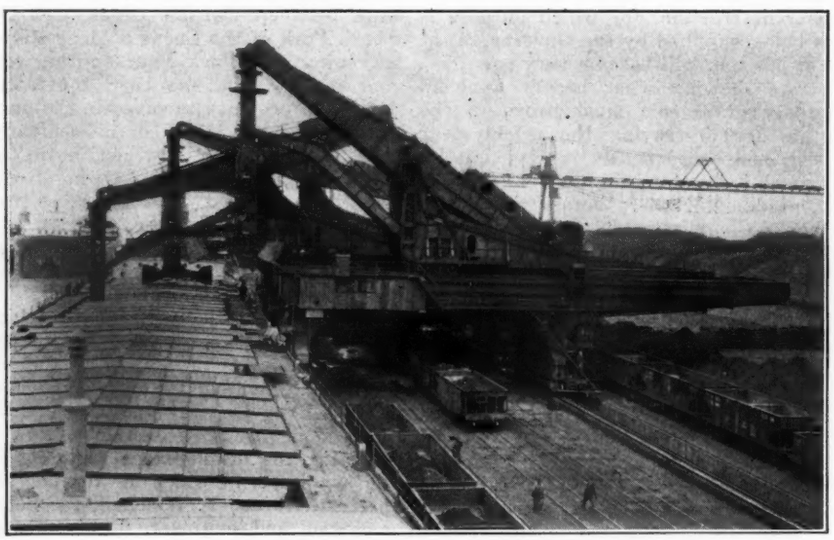
In Cobalt there are probably 500 members, but a certain impetus has been given to the organization by the recent election in the Temiskaming district, when a labor-farmer candidate was elected. This candidate is generally credited with being a "red," and there certainly was great jubilation in the O. B. U. headquarters when the result of the election was made known.

In the Sudbury field the International Nickel Co. and the Mond Nickel Co. seem to be fairly free from any influence of the O. B. U. This is probably due in part to the fact that they own all the land and houses in which employees live. The organization is, however, making headway with the employees of the British America Nickel Corp., as at this company's property a large number of new men have been introduced and the company has, as yet, little accommodation for them.

The O. B. U., in addition to having internal dissensions, has to fight the older unions. Unfortunately, however, it attracts the radical element, which is always a big factor in any labor dispute.

Lake Navigation About To Open

Officials of the Weather Bureau state that it will be possible for Lake freighters to get into Lake Superior from the Lower Lakes by about April 25, and it is certain that ore loading will be under way at Lake Superior ports by that time. Some of the ore carriers wintered at the head of the Lakes and will be the first boats to be loaded this season with iron ore. The ice is gradually leaving the harbors and the St. Mary's River. Cars have already been sent to some of the mines on the Mesabi Range for loading, but no loading has taken place as yet in the Michigan district. The operators are anxious to get started, as they have large contracts to fulfill. The Oliver Iron Mining Co. has placed an order for 100 additional all-steel dump-cars for use at its mines on the Mesabi Range where overburden is being removed. Some of the railroads have ordered more cars in order to take care of the increased traffic. It is certain that most mines will be steady shippers within a very short time.



UNLOADING IRON ORE FROM LAKE BOAT AT U. S. STEEL CORPORATION'S DOCK, CONNEAUT, OHIO

Cobalt and Nickel Plant Purchased at Welland, Ont.

The Ontario Smelters & Refineries, Ltd., of Chippewa, Ont., has completed negotiations for the purchase of the plant and property of the Metals Chemical Co. of Welland, which has been closed for some time. The latter company was engaged in refining ores, high in cobalt and low in silver, and in the production of metallic cobalt and nickel and their salts. The plant had small capacity and was not designed for treating ores carrying any considerable amount of silver. It was refinanced more than once, but on account of its small capacity and its limited number of products was never a financial success. Both the Deloro and Thorold plants, with which it had to compete, produced silver and refined arsenic. It is understood that after the plant was closed, the Coniagas smelter at Thorold purchased the residue and speiss on hand. The land, buildings and equipment, together with the balance of the metal residues on hand, which is being taken over by the Ontario Smelters & Refineries, Ltd., is valued at $475,000.

Cobalt Wages Drop in April Owing to Fall in Silver

Scale Twenty-Five Cents Lower in Accordance with Agreement Between Men and Managers

For the first time in many months the Cobalt wage scale in April will show a decrease. According to the agreement between the men and the managers, the former, in addition to a flat scale, are paid a bonus of 25c. a day on 80c. silver and 25c. a day for each 10c. advance in the price of silver over 80c., the average for the month of Handy & Harman's quotations being the determining figure. The recessions in the price have been small compared with the advances, during the last year, so that for this period wages have been constantly advancing, with no recessions. During March, however, silver sold below $1.30 and wages in April will be 25c. a day less than in March. The men can have no legitimate cause of complaint, but the O. B. U. will, no doubt, use this point to try and cause dissatisfaction among them. When the bonus system was first introduced, silver remained about stationary for some time, and some of the men now most active in the O. B. U. claimed that this was the result of manipulation by the Cobalt mine managers to prevent the men getting more wages.

Recent Production Reports

Calumet & Hecla and subsidiaries produced 9,880,577 lb. copper in March against 8,660,052 lb. in February. Production was as follows: Ahmeek, 2,031,800; Allouez, 428,400; C. & H., 5,183,523; Centennial, 97,284; Isle Royale, 1,079,900; La Salle, 0; Osceola, 773,800; Superior, 0; and White Pine, 285,870.

Compagnie du Boleo, Santa Rosalia, Baja California, produced 1,193,416 lb. copper in March against 911,051 in February.

North Butte produced 1,833,176 lb. copper in March compared with 1,768,509 in February.

Utah Copper produced 8,894,596 lb. copper in March against 9,211,806 in February.

Ray Consolidated's March output was 3,900,000 lb. copper against 3,885,000 in February.

Chino Copper produced 4,413,329 lb. copper in March against 3,176,489 in February.

Nevada Consolidated produced 3,700,000 lb. copper in March compared with 3,850,000 in February.

Burma Corporation in February produced 5,734,400 lb. lead from 6,642 tons of lead-bearing material. Production of refined lead was 4,054,400 lb. and of refined silver 226,720 oz.

NEWS FROM WASHINGTON

By PAUL WOOTON
Special Correspondent

Bill for Establishing Budget System Reported to Senate

Committee Will Consider Question of Reorganizing Executive Departments Soon

In carrying out the policy of the present Congress to do everything possible to establish a national budget system, the special committee headed by Senator McCormick has reported out, with amendments, the bill which passed the House a short time ago. The principal change places the budget bureau in the Treasury Department rather than in the President's office. The committee expresses the opinion that the budget bureau in the office of the President would be an anomaly in the Government.

The committee considered relieving the Treasury Department of certain bureaus not germane to its primary functions, including that of the supervising architect and the Public Health Service. Encouragement was held out to the engineers interested in obtaining a Department of Public Works by the conclusion of the committee that "general legislation looking to the reorganization and better co-ordination of the executive departments" would be considered in the near future.

Other variations in the House bill are as follows:

"1. There is provided instead of the director and an assistant director of the Budget Bureau, a commissioner and two assistant commissioners, who shall be appointed by the President, with the advice and consent of the Senate, and who shall hold office for a term of six years. All other employees of the bureau are placed under the civil service rules. (Sec. 3.)

"2. There is provided in each of the departments and establishments of the Government 'a general financial secretary' who shall have supervision over the formulation and the preparation of the budget estimates for his respective department or establishment. This is to insure careful scrutiny and co-ordination of effort in arriving at the financial needs of the spending departments. (Sec. 5.)

"3. The head of each department and establishment is further required to study, analyze, and revise his budget estimates before they are finally submitted to the Commissioner of the Budget. This is in order to fix the responsibility upon the department heads for the financial demands which they propose to make upon the Treasury. (Sec. 6)

"4. On or before Oct. 1 each year the head of each department and establishment is required to submit to the Commissioner of the Budget 'his final revised budget estimates for the ensuing fiscal year.' (Sec. 6)

"5. The head of the departments are further required, when their budget estimates are in excess of existing appropriations, or when they are entirely new, to set forth in detail, by means of a note, the reasons why such increase or new item is requested. (Sec. 9)

"6. It is made the duty of the Secretary of the Treasury to prescribe a uniform system of rules and regulations regarding the form and the method of the preparation and submission of budget estimates. (Sec. 10)

"7. The Commissioner of the Budget takes over the functions of the division of bookkeeping and warrants in so far as they relate to the estimates. (Sec. 11)

"8. On or before Nov. 1 of each year the Commissioner of the Budget is required to report the results of his investigations regarding the organization activities and methods of business of the various services of the Government, in the interest of securing economy and efficiency, to the Secretary of the Treasury. He is also required on that date to submit to the Secretary of the Treasury the budget estimates which have been submitted to him. (Sec. 12)

"9. It is made the duty of the Secretary of the Treasury to 'revise, consolidate, unify, co-ordinate, reduce or otherwise to change any item or items of the budget estimates submitted to him' in the interest of economy and to prevent waste, extravagance, loss, or duplication. (Sec. 13)

"10. On or before Nov. 20 each year the Secretary of the Treasury is required to submit to the President the budget estimates in the form of a national budget (of prescribed form)."

Further Awards Made in Chrome and Manganese Cases

Eleven of Former and Three of Latter —Total Amount Involved About Eighty Thousand Dollars

Additional awards totaling $80,352.75 have been made by the War Minerals Relief Commission. The award in each chrome case and the percentage of the amount recommended to the amount claimed is given as follows: W. E. Gilmore, $2,011.14, 25 per cent; C. B. Fife, $1,172, 93 per cent; Frank L. Waller, $2,657.99, 28 per cent; Norman Kerr, $347.70, 59 per cent; Fresno Chrome Co, $3,048.28, 9 per cent; P. L. Papish, $738.48, 6 per cent; Anderson, Hilbert & Robinson, $345, 27 per cent; Young, Milne & Reichman, $2,993.81, 65 per cent; A. J. Schmidt, $1,851.08, 60 per cent; John H. Haak, $34,888.54, 58 per cent; George W. Elder, $1,491.60, 61 per cent.

The following awards were made in manganese cases: H. K. Welch, $26,-889.87, 70 per cent; J. D. Magness, $1,422.22, 11 per cent; W. S. Jones, $495.04, 67 per cent.

Radio Station Asked for Hyder, Alaska

In urging an appropriation for additional radio stations in Alaska, it is predicted by the Governor of Alaska in a letter to the Secretary of War that 3,000 men, at least, will be employed this summer in and around Hyder, as a result of the recent silver discoveries in that neighborhood. Governor Riggs predicts that this will be one of the phenomenal camps of North America. He vouches for one instance in which $265,000 worth of silver was secured from 400 tons of ore. The cost of the station was estimated at $30,000.

STATUS OF PENDING MINING LEGISLATION

Bills That Have Reached Committee Stage

Subject of Bill	*Bill No.*	*Author*	*Present Status*
Silver in coins	*H.R.* 11,226	*McFadden*	*Before House Committee*
Met. Min. on Ind. Res.	*S.* 287	*Ashurst*	*On Senate Calendar*
Timber for mining purposes	*S. No.* 1	*Pittman*	*Passed Senate Oct.* 3, *before House Committee*
Anti-dumping	*H.R.* 10,918	*Fordney*	*Passed House Dec.* 9, *on Senate Calendar*
Laboratory glassware	*H.R.* 7,785	*Bacharach*	*Passed House Aug.* 2, *on Senate Calendar*
Magnesite	*H.R.* 5,218	*Hadley*	*Passed House Aug.* 7, *on Senate Calendar*
Tungsten	*H.R.* 4,437	*Timberlake*	*Passed House Aug.* 21, *on Senate Calendar*
Zinc	*H.R.* 6,238	*McPherson*	*Passed House Sept.* 2, *on Senate Calendar*
War Minerals Relief	*H. R.* 13,091	*Garland*	*Reported favorably to the House March* 25.

NEWS BY MINING DISTRICTS

I. W. W. Calls Strike at Butte

No Notice Given—Demand $7 for Six-Hour Day, Release of Prisoners and Abolition of Contract System

By Telegraph

A strike was suddenly called at Butte by the I. W. W. union of miners late on Sunday, April 19, and effective the morning following. No demands were presented to the companies nor was any notice given at this time. On Monday, squads of pickets, made up principally of Finlanders and Bulgarians, stopped miners on their way to work, snatched their dinner buckets and thrust I. W. W. and radical Soviet literature into their hands. Their demands, as later published in the daily newspaper of the I. W. W., were for a six-hour day and wages of $7 per day, and for the release of all political and industrial prisoners, and for the abolition of the contract system, whereby a miner is paid for what he does.

The average wage paid by Anaconda for 13,000 shifts during the last week was $7.43 per day. At Anaconda's West Colusa mine, the daily wage for the last week under the contract system averaged $8.35. The contract system is gradually weaning men away from the control of the radical unions.

The strike is not expected to last long. The great majority of the miners, not being affiliated with the I. W. W., prefer to remain at work, this according to opinion in well informed labor circles. The men, however, do not care to risk assaults of foreign pickets. On Monday, April 19, about a third of the shifts were at work.

ARIZONA

El Tiro Reports for March—Mica Found Near Ajo—Van Dyke Sinking on Ore in Pinal Schist—U. V. Co. Has Magazine Explosion—Arizona Power Co. Completes New Line

Miami—Almost within the business district, the Van Dyke Copper Co. has been sinking on the copper deposit cut several years ago by drilling. The top of the orebody was found at 1,180 ft., 20 ft. below the strike in the drill hole. The ore is carbonate high in silica and typical of this section. It is described as "in much brecciated and silicified Pinal schist, and the copper minerals, mainly malachite, azurite and chrysocolla, occur in crystalline form within the fractures." E. R. Rice, manager, states: "The present strike demonstrates absolutely the presence of orebodies of commercial grade lying in the Pinal schist, underneath the Gila conglomerate and to the east of the Miami fault."

Tucson—At Silver Bell, Percy Williams, manager of El Tiro Leasing Co., reports shipment in the last month of 26 carloads of ore, produced at a cost of 18.19c. a pound. Though 568 ft. of development work was figured in this, there was a net profit for the month of $783. On the 300 level are altered ores in limestone, leading to the belief that soon there will be found a body of sulphide of good grade, entirely distinct from the ores mined on the upper levels.

Ajo—Ten miles west of Ajo, Ellsworth Gibson has located a ledge of commercial mica, 15 ft. wide, exposed for 200 ft. A similar ledge has been found in the Estrella Mountains, on the Pima Indian Reservation.

Jerome—An explosion in the magazine of the United Verde Copper Co. recently caused serious injury to Grant Dunlop and sent four other persons to the hospital, but there were no deaths. Some of those injured were scalded through the breaking of a powerhouse steam pipe and the others by falling fragments. One end of the mine office building was blown in, the power house was almost wrecked and windows were broken in Jerome, nearly a mile away.

Calumet & Arizona's annual report says of the Gadsden Copper Co.: "Work at Gadsden failed to show mineral values and unless work planned at the end of the year is fruitful of results, operations will be discontinued." Development has already been stopped. No ore was found although 5,619 ft. of this work was done.

Globe—Arizona Commercial's recent report to stockholders states that all of the development to date has indicated that the company's claim made against the Iron Cap Copper Co. a year ago, which was followed by a suit against that company, can be definitely established by physical facts and not by geological hypotheses.

Superior & Boston shipped 15 cars of ore in March averaging 6 per cent copper and over 13 oz. silver.

Johnson—H. D. McDonald, formerly of Mascot, Tenn., is sampling the Arizona United Mining Co. property. He is said to represent parties connected with the American Zinc, Lead & Smelting Co.

The machinery at the Golden Rule mine at Cochise has been purchased by Dr. Kopp, of Denver, Col., and moved to Gleeson, where it will be used to develop property owned and operated by him.

The Johnson Development Copper Co. has installed pumps and is unwatering the lower level preparatory to development work.

Phoenix—Stability of power service both for the mining districts of Yavapai County and the agricultural sections around Phoenix has been assured by completion of a connecting line of the Arizona Power Co., which may now draw upon its two Fossil Creek hydro-electric plants, its 10,000-kw. steam generating station near Clarkdale, its steam generating station in Phoenix, and upon the great hydro-electric system of the Roosevelt irrigation enterprise. The new line will furnish power to the Kay Copper Co. and other properties that are situated in the Black Canyon district north of Phoenix.

South Verde Consolidated is installing an engine and compressor on its copper property in the Cave Creek district, 50 miles north of Phoenix. A tunnel, 580 ft. long, is entering the vein matter. The company is mainly capitalized in Mesa, where its headquarters are.

A 15-ton Nissen mill is being installed at the Eyrich gold mine, 20 miles north of Phoenix in the Winifred district. A 360-ft. shaft and drifts have opened up a 3-ft. vein sampling above $25. John F. White, of Phoenix, is manager.

ARKANSAS

Manganese Mining Reviving in Batesville Field

Batesville—Walter Dennison, one of the largest shippers of manganese ore in the Batesville field, states that enough contracts have been made with the furnaces to consume the 1920 production of the field. The ore is going to Chicago concerns. Demand is for 40 per cent ore which is bringing 70c. per unit. Present producers are the Independence Mining Co., Dennison & Adler, Walter Dennison, Ozark Mining Co., Potteroff & Co., Dennison & Barksdale, Stanley Hanford, T. F. Shell, Dennison Bros., and the White River Manganese Co. The Eureka and the Oklahoma-Kansas companies are to start their washing plants within the next ten days.

IDAHO

Bunker Hill Smelter Getting About 6,000 Tons Custom Ores Per Month

Wallace—The new mill of the Big Creek Mining Co., which has been under construction during the winter, was started on April 9. It has a daily capacity of 75 tons and is equipped for concentration and flotation. The ore is galena, which is high in silver, and gray copper. It is estimated that there is 4,000 tons of low-grade milling ore on the dump.

Kellogg—The Bunker Hill & Sullivan smelter is now securing about 6,000 tons of custom ore per month in addition to the production from the company's own property Custom smelting was only recently undertaken.

MICHIGAN

Copper District

Mayflower Crosscut Through Vein into Trap — Mohawk-Wolverine Intake Tunnel Finished and Mills Being Remodeled

Houghton—Mayflower's crosscut is in 100 ft. through the mineral and into the trap, in line with expectations.

Superior's exploration program continues. In addition to work in the shaft laterals, diamond drilling is being done to assist in development. A shipment of 350 tons of West lode matter, taken out in the openings, was made last week.

Quincy's stamp mill is using 260 Deister tables and finds them satisfactory. A small number of these tables set on Wilfley machines are also used.

Calumet—Calumet & Hecla has a year's supply of coal on hand. Every other mine in the district has enough coal to last for at least 90 days from this date. The company is now shipping part of its leaching plant product direct without smelting. Two cars of copper oxide leave Lake Linden weekly for the American Carbon company at Philadelphia, where it is used in making generator brushes. A high price is said to be secured for this. One order was also received this week from Italy.

Gay—At the Mohawk and Wolverine mills at Gay some extensive remodeling is being done. New Hardinge mills and tables are being installed, eight of the former and 100 of the latter. Savings, proven by experiments, may be hoped for on a basis of 1½ lb. per ton, approximating $5 a year a share on the present production.

The tunnel constructed to assure a steady water supply has been completed. It was built in 18 months at a cost of $20 per ft. It is 2,800 ft. long. Pumping is being done with power from the low pressure turbine, a 1,250-kw. equipment, running on exhaust steam from the stamp heads. This same turbine will furnish the power for the regrinding mills and additional tables.

Mohawk is operating 65 machine drills. Sinking is being done at No. 4 and No. 6 and drifting in Nos. 4, 5 and 6.

Menominee Range

Iron Mountain—The Iron Mountain Furnace Co. has been organized to erect a charcoal pig-iron furnace here. The $400,000 required has been subscribed, $175,000 in stock having been taken by Iron Mountain residents. The capacity of the furnace will be between 80 and 100 tons of iron daily. Ore will come from the West Chapin mines and limestone and charcoal from near the city. M. E. Richards, formerly in charge of mining properties in the Crystal Falls district, is to be manager.

The Traders mine at Iron Mountain is to resume operations in April after being idle last year. The machinery is being overhauled and over 100 men will be employed this summer. The operators are the Antoine Ore Co., a subsidiary of the Republic Iron & Steel Co.

Crystal Falls—Almost every mine in the district which was idle last year is now in operation or will be this month. Many of the miners who left the district have returned to their former employment.

Escanaba—The North Range Exploration Co. has not as yet been successful in its search for iron ore in the Escanaba field, which is considered by some as an extension of the Menominee Range. One diamond drill has been at work for several months and the formation has been cut, but no ore has been found. Several holes have been put down and it is likely that the work will go on all summer.

Iron River—The Delta mine has been sold by the St. Clair Mining Co. to the Wickwire Steel Co. and work has been resumed. Ore hoisting must wait until some new machinery is installed. A spur off the C. & N.-W. main line will be built to the property. A new headframe is to be erected later. Most of the machinery will come from the Wickwire mine. The property has not been worked by St. Clair since 1916.

The Smuggler mine, idle since 1913, has been sold by the Youngs Mining Co. to the Florence Iron Mining Co., which will start mining soon. Electrically-driven machinery has been ordered, including a hoist, a compressor and smaller machinery. Pumping will be resumed promptly. About 700,000 tons of ore was removed before the shut down. The manager will be Andre Formis, also in charge of the Bates Iron Mining Co.'s mines.

Cleveland-Cliffs will resume operations soon at its Spies mine in the Iron River district. Considerable ore is in stock that will be shipped this year, but not enough to meet contracts.

Marquette Range

Negaunee—Operations will be resumed soon at the Jackson mine of the Cleveland-Cliffs Iron Co. This is an open pit property which is worked only during the shipping season.

The large crushing plant at the Cleveland-Cliffs Iron Co.'s Maas mine is being placed in condition for operation. Much hematite ore mined in the Ishpeming field is crushed at this plant. The company has several central crushing plants that operate during the shipping season instead of installing crushers at the individual mines.

Ishpeming—It will take two months more to dewater the old Cleveland mine, which has been idle for years. Pumping has been going on since last fall. An electrically driven pump is mounted on a cage in the old vertical shaft and is lowered as the water level goes down. The water is being removed to insure greater safety in the workings of the Cliffs shaft, which has openings not far away.

Gogebic Range

Ironwood—The Ashland mine in Ironwood, Mich., on the Gogebic Range, has had a narrow escape from being drowned out. The mine is being developed on the 20th, 22nd, and 24th levels, and recently has had to handle increasing amounts of water as is common in many mines in the spring. A week or so ago the pumps on the bottom level broke down under the extra load, and were drowned before they could be repaired. The 24th and 22nd levels were flooded within a day or two, and the rising water was not checked until it was within a few feet of the 20th level. Two pumps were borrowed from the Norrie-Aurora mines with which the water has been lowered about 140 ft. below its high level. The drowned pumps should be recovered shortly although unwatering the two levels will take much longer than unwatering the shaft. Development at the Ashland has been progressing favorably; a cross-cut at the west end of the 20th level has gone 40 ft. in high-grade ore.

A steam shovel has been received at the Townsite mine and is now erected and ready to start loading the stockpile as soon as the shipping season opens. The U. S. Bureau of Mines rescue car is now at this mine.

MONTANA

Butte—Production of zinc ore particularly is being speeded up by Anaconda, which is producing more zinc than at any time in its history. An increased zinc output in turn will increase the silver yield.

Daily shipments from the Davis-Daly are running 325 tons and over, the ore recently running over 8 to 10 per cent copper with from 6 to 8 oz. silver. Ten thousand tons of ore was shipped during March.

Net earnings of Tuolumne Copper in March were over $12,000 from the proceeds of 45 cars of ore shipped to the Washoe Reduction Works.

From unofficial sources comes information to the effect that an option has been given on a controlling number of shares of the Butte & Ramsdell, adjoining the Davis-Daly on the east, and it is believed that interests associated with the latter have taken the option, although this has not thus far been confirmed.

Marked improvement is reported in the grade of ore on the 3,400-ft. level of the Edith May vein of the Granite Mountain mine of the North Butte company. The copper content is said to run up to 8 per cent.

Grade of shipments of siliceous ore from the glory hole of the Butte & Duluth, being worked by the Mines Operating Co., is said to be improving.

Potomac—The breast of the No. 4 tunnel, the principal working of the Potomac company, again is in ground seamed with fine stringers of copper glance. It will be at least 60 days before this tunnel reaches the point for which it is being driven.

NEVADA

Yellow Pine Strikes Pay Shoot on 1,000 Level—Simon Silver Lead To Build Pilot Mill

Goodsprings—The downward extension of the orebody which has produced so well for the Yellow Pine Mining Co. has been struck on the 1,000 level, 600 ft. north of the shaft. The ore is smithsonite with bunches of galena. The mill treats 60 tons per day and in February the net realization was $32,000.

At the Yellow Pine mill, U. S. Bureau of Mines men have been carrying on volatilization tests, with the idea of driving off silver and lead and precipitating them from fumes by the Cottrell process. The tests were made in a calcining furnace 60 ft. long and 5 ft. in diameter.

Samuel S. Arentz has been experimenting with the treatment of vanadium ores at Goodsprings, Nev., and recently shipped to a vanadium company in Colorado a 350-lb. sample of high-grade concentrates. Vanadium ores are found scattered over considerable territory in the Goodsprings section. Arentz states that E. F. Gordon, representing the Schwab interests, spent six weeks in the district looking at different deposits of such ores.

Tybo — Three cars of coke for the newly-built smelter of the Louisiana Consolidated company, at Tybo, has arrived at Tonopah and is being hauled by trucks to the camp, 60 miles northeast of Tonopah. It is hoped to accumulate a sufficient reserve supply. The plant will be of 125 tons capacity. Slag from the old pile, which accumulated when the first Tybo smelter was operated in the Sixties, will be mixed with the mine ore. F. W. Draper is general manager.

Omco—Following a report by Fred Searles, Jr., it has been decided to rebuild the Olympic mill on the site of the one destroyed by fire some months ago, 22 miles east of Mina. The new mill will be of 40 tons capacity and will cost about $100,000. Cyaniding will be employed.

Simon District — The Simon Silver Lead Mines Co. has increased its capital stock from $1,500,000 to $2,000,000, a step required in order to secure funds for a reduction plant, a new road between mine and shipping point at Mina, development of water and necessary pipe lines to convey it to the mill, and other important improvements. The Simon ores are not simple to treat and it has been given out that a small mill will be built and the reduction process thoroughly tried out before a larger plant is put up.

Tonopah — Although earnings of Tonopah companies were low for February, owing mainly to labor disturbances early in the month, it is expected that March earnings will prove approximately normal. The last regular semi-monthly cleanup for the district totaled approximately $250,000.

Tonopah operators are working for the passage of the McFadden bill, calling for an excise to be paid on all gold used in the arts. Passage of this would be of considerable benefit to the Tonopah district, as the ratio of silver to gold is 100 to 1, by weight, in this district. It would also benefit the subsidiary companies of the Tonopah corporations operating in different parts of the world, some of which are having trouble making ends meet owing to increased costs.

The Tonopah Mining Co. has announced resumption of dredger operations on its property at Breckenridge, Colorado.

Divide — No special developments have been recorded in the Divide district recently. The adjourned meeting of the Tonopah Divide company was held April 10 in Tonopah. Out of a total of 1,000,000 shares issued 735,000 shares were represented at this meeting. The entire board of directors were re-elected for the ensuing year. The officials are H. C. Brougher, president; George Wingfield, vice-president; W. J. Douglass, second vice-president; E. J. Erickson, secretary-treasurer. Directors are H. C. Brougher, George Wingfield, W. J. Douglass, E. J. Erickson and E. W. Blair. The annual report of mine development, expenditures and receipts will probably not be mailed to stockholders for another week.

Jett Canyon—The Gibraltar mine, located in Jett Canyon and about 10 miles west of Round Mountain, held under option by W. J. Loring and associates, is reported to have been closed. Development under bond failed to disclose ore at depth.

Majuba Hill — The Majuba-Fresno Silver Mining Co. has shipped three cars of smelting ore averaging $60 from its recently acquired Last Chance mine. C. E. Crawford is manager.

Pioche—Prince Consolidated has almost completed its new change house. The shaft is now down 600 ft. vertically and has 225 ft. to go to cut the first ore bed.

Negotiations for reopening the old Mazeppa mine are pending.

Ore shipments from the Pioche district in the week ended April 8 totaled 1,800 tons as follows: Prince Con. 600 tons, Virginia Louise 750, Black Metals 150, Con. Nevada Utah 150, Combined Metals 100, and Pioche Assay Office 50. Shipments are below normal owing to the labor situation.

NEW MEXICO

Lordsburg—The Misers Chest Syndicate, composed of bankers and mining men of Silver City and Tyrone, N. M., have decided to increase the scale of operations at this property. More men will be added to the underground force. Three cars have been shipped so far in April to the El Paso smelter. An effort has been made to lease some of the adjoining Bonney ground. James B. Bell is manager.

The option taken by Frank Cavanagh and associates, of Philadelphia, on the Nelly Gray mine, will not be taken up.

OKLAHOMA

Several Plants Completed and Others Are Resuming Operations—Tornado Damages Blue Bonnet Plant—Commerce M. & R. Co. To Build Mill

Picher—Several new plants have been completed and operations resumed at others that have been down for some months. Among those recently completed is that of the Empire Development Co., which is the remodeled Kentex mill, now situated northeast of Hockerville, Kan. The Jeff City mill is completed and operating steadily. The Lucky Syndicate is just finishing the mill it purchased and moved from Joplin to replace the one lost by fire two years ago. The State Line is just completing a new mill northwest of St. Louis, Okla. The Hunt Mining Co. has practically completed a plant to replace the one lost by fire about two months ago. The St. Louis S. & R. Co. has completed and put in operation the old Coahuila mill, moved from near Duenweg, Mo., to the Kropp land, two miles east of Picher.

Resumption of operations has been particularly noticeable in the field about two miles east of Quapaw, known as Sunnyside. The West Virginia mill, the second to be built upon one lease, is operating steadily. The Morgan mill, built some time ago, but never successfully operated, has been taken over by the Bar H Mining Co., of Oklahoma City, and is being overhauled. The Charlotte mill at Sunnyside was recently completed and placed in operation. The Aurora mine, owned by interests in Aurora, Mo., has been placed under the management of Dr. C. A. Moore, of Aurora, and will be started up at once.

The Kropp mill of the St. Louis S. & R. Co. is interesting in that Hancock jigs are being used in it, the first in this district. Results obtained with them are being watched.

A tornado destroyed two tramways, a derrick and hopper and blew in the roof of the Blue Bonnet mill of the Victory Metals Co., about two miles east of Picher, at 5:30, Sunday evening, April 10. Eight men were working in the plant at the time but none was injured. Three of the men were just preparing to descend into the No. 4 shaft, where the derrick and hopper were destroyed, when the storm struck. John C. Cox, superintendent of the property, estimates the damage at $35,000, and the plant will be idle several weeks until repairs can be completed. The tornado, while small, was typical, developing a funnel-shaped cloud that was observed all over the field. K. S. Bell, assistant superintendent at the St. Louis S. & R. Co. plants, one mile east of where the storm struck, saw the cloud and took a kodak picture of it. The cloud dipped to earth just before it reached the Blue Bonnet property and then almost immediately lifted once more, coming down for an instant, about a mile to the northwest, and wrecking the barn and roof of the home

of Nicholas Gilmore. Fortunately the storm travelled along the very eastern edge of the Oklahoma mining district, and there were few mills in its path.

The Big Chief mine at Picher has recently been taken over by John Skinner and R. C. English, of Webb City, Mo. The mine was developed by officers and employees of the Eagle-Picher Lead Co., and has been a good producer.

SOUTH DAKOTA

Water in Homestake Below 1,750 Level; 840 Stamps Dropping — Activity Looked for in Keystone District

Lead—Water in the Homestake mine has been lowered below the 1,750-ft. level and work has begun at this depth. In a short time the entire workings will be in the same condition as they were in before the fire, which started last September. Since the increase in wages, labor is more plentiful and a return to normal production will probably be reached this summer. Out of a total of 1,020 stamps 840 are now dropping.

Trojan — The Trojan company continues active work in the Bald Mountain district. The shaft started early last fall is still being sunk. The upper 50 ft. has been concreted and the new opening is being permanently equipped.

Deadwood—The tunnel being driven in the Carbonate district has reached a depth of nearly 1,000 ft. This leaves about 350 ft. to drive to tap the lower workings of the old Iron Hill property. When this is completed the old workings will be thoroughly prospected. The new tunnel will make it possible to drain the mine, and will also pass through virgin ground. Several vertical stringers of ore have been cut, which are being developed.

The Cutting continues active development west of the Homestake holdings. Sinking is being continued and has reached a depth of over 300 ft. When the 500-ft. point is reached, laterals will be driven and ore deposits found near the surface developed.

Galena—The Anchor Mountain Co., which erected a ten-stamp amalgamation plant in 1919, is continuing mine work. A tunnel is being driven to cut the orebody with depth and is now in over 200 ft.

The New Silver Queen continues to ship lead-silver ore to the smelter in Colorado. Various deals are pending in this lead-silver district. Such properties as the Richmond-Sitting Bull, Merritt and Horseshoe are producing regularly.

Keystone — The Maywood Chemical Co., Rheinbold Met. Co. and Bob Ingersoll mine are preparing for active work. The first is the largest shipper of amblygonite in the state, producing annually about 1,000 tons, which is shipped to New Jersey. The other two ship lithia ores, mica, beryl and columbite. The district is expected to be active. The merger of the larger gold properties will probably be completed and work started on a large scale early this summer.

CANADA

British Columbia

Stewart—It is announced that certificates of incorporation have been issued to two companies for operating an express service by hydroplane between Stewart, B. C., and Long Lake, the latter being close to the Premier mine and other prospects of the Salmon River section, in the Portland Canal district. Roy C. Price is mentioned as the organizer and the manager of the enterprise and it is said that funds are being advanced by business men of northern British Columbia and that terminal facilities have been arranged for.

Dale L. Pitt, manager of the Premier mine, has returned to the property accompanied by two engineers of the American Smelting & Refining Co. Mr. Pitt states that it is the intention to continue diamond drill development. The engineers are to supervise plans for construction of a new mill. The company will continue to ship high-grade ore.

White Horse.—A body of high-grade copper ore has been disclosed at the Copper King mine, near White Horse, Y. T., and a considerable quantity has been sacked ready for shipment when the weather improves.

Alice Arm.—A. J. T. Taylor, managing director of the Taylor Mining Co., having returned from Alice Arm, states that it is expected that the railway will be cleared of snow and the shipment of ore by rail rendered possible some time early in May.

Hazelton.—The opening of a new 2-ft. vein of good milling ore is reported at Silver Standard. Development is continuing. Necessary alterations and repairs have been made to the mill and operations were recently begun.

Kamloops.—A car of high-grade ore from the Joshua mine of the Donohue Mines Corp. awaits shipment to Trail. More concentrating machinery is to be installed to bring the mill capacity up to 25 tons a day.

Sheep Creek.—The Motherlode mill, of the Nugget Gold Mines, Ltd., is being overhauled and will be ready in May.

Ymir—The Mining Corporation of Canada has taken up its bond on the Yankee Girl gold mine at Ymir, B. C.

Victoria—Stockholders of the Coast Copper Co. have decided to defer construction of a mill at the Sunloch Group on Vancouver Island.

Grand Forks—The Provincial Government has decided to diamond drill certain properties at Franklin Camp, close to Grand Forks. The Mitchell Diamond Drill Contracting Co. is preparing to start work under the direction of P. B. Freeland, district mining engineer, as soon as weather permits.

Texada Island—The Calumet & Arizona Mining Co. is reported to have purchased the Cornell copper property belonging to the Van Anda Group. The property was bonded to the C. & A. Co. two or three years ago.

Ontario

Cobalt—The Beaver Mines, of Cobalt, has reported that developments on the 1,400-ft. level were encouraging. An option has been taken on the Prince and Badger properties. The ground below the diabase sill will be explored. The Beaver vein on the 1,400-ft. level has been worked close to the Prince line. A dividend of 3 per cent is promised before the end of May.

The Dominion Reduction Co. and the Peterson Lake Mining Co., of Cobalt, have completed an arrangement for the treatment of the tailings in Peterson Lake. These are from the Dominion Reduction mill, and belong about equally to both companies. It is understood that there is a total tonnage of about 220,000 averaging approximately 4 oz. to the ton, of which probably 3 oz. will be recoverable. No definite announcement has been made as to the basis on which the tailings will be treated.

Preliminary arrangements have been made, and work is to be started shortly on the Bailey property, which is now amalgamated with the Northern Customs Concentrators, Ltd. The new company took over the property as of April 1. It is understood that there is a considerable tonnage of milling ore in sight. The Northern Customs is dewatering the old No. 2 shaft of the Chambers-Ferland, which ground it purchased a few months ago. There is a considerable quantity of mill rock available.

Larder Lake—At the annual meeting in Toronto of the Associated Gold Fields Mining Co., Ltd., it was announced that construction of a 1,000-ton mill has been started, and that the first unit will be followed by others until an aggregate of 10,000 tons daily is being treated. Accommodations for 500 men will be built this summer. The directors have ordered the development of additional electric units at Raven Falls.

The attitude of mining engineers in Northern Ontario toward this proposition is very critical. Little information of value has been given to shareholders, and estimates regarding ore reserves and the average value of the ore is, to say the least, vague. On account of the amount of money which the company has succeeded in raising from the public, it has been suggested that the property should be investigated by officials of the Mines Department of Ontario.

Kirkland Lake—The Wright-Hargraves will, it is understood, start operations on the new mill about the end of April. This property is considered to be about the most promising one of Kirkland Lake.

Preparations are being made to reopen the Tough-Oakes, which has been closed down for about a year.

A statement was recently made by the directors of the Ontario Kirkland that the company plans to erect a mill. If this is finally decided upon, the construction will probably begin sometime this year.

ECHOES FROM THE FRATERNITY

SOCIETIES, ADDRESSES, AND REPORTS

J. E. Spurr Addresses Graduating Class of the Michigan College of Mines

The graduating exercises of the Class of 1920 of the Michigan College of Mines, at Houghton, Mich., were held on Wednesday, April 14. The president of the college, F. W. McNair, had requested Mr. Spurr to make the address of the day. In addressing the graduates Mr. Spurr said in part:

"You must realize that through your training and studying and working you will lead quite different lives than if you had not chosen to become college men. Your mining engineer must be, to be sure, a plain and ready fellow, still he must be an engineer after all.

"What is success? You must know what you are aiming for, or you will never arrive. Concentration is a great thing; if you are sufficiently modest in your ambitions and concentrate on them hard and persistently, the chances are ten to one that you will obtain them.

"Do you want to accumulate money? Wealthy men are the commonest things in the world—it is the easiest way of arriving at a sort of mediocre prominence. Mining is a noble industry—none finer. A clean mining engineer may well hold up his head, for he is a moral and economic aristocrat. The miner takes his wage from the earth—like the farmer and fisherman. No man is the poorer by his prosperity; indeed, he cannot thrive in mining without adding wealth to the common store as well.

"When I speak of the nobility of mining, I mean mining the earth, not mining the public. Herbert Hoover has done many things besides feeding the Belgians and keeping us out of sugar; he has made the stock of the mining engineer quoted higher in the Eastern States than ever before. Very few people are asking 'Who's Hoover?' these days, and ten years from now there will be even fewer.

"It is a great thing to do things—real things and constructive—because we like it and for our own betterment; it is a greater thing to do things because they benefit others besides ourselves. And this brings me finally to the mining engineer in his development as a citizen. Engineers have a great duty. The war has brought many engineers, like Hoover, out of retirement and forced them into public life.

"Our great social trouble lies in the lack of understanding between groups. The remedy is the Truth—turn on the light!

"The engineer is a great producer—his years of study and apprenticeship and the creative ability which he thereby attains entitle him equitably to a larger proportion than the less intelligent, less creative individual.

"The future of the world belongs to the engineer. The engineer, Hoover says, thinks quantitatively while others do it qualitatively. He does not deal so much with the variable psychology of human nature as the lawyer and the business man; he deals more with facts and inalterable laws. His reasoning must pierce through the clouds of sophistry, of self-interest and of sympathy. He must lay facts before a board of directors, even when they are unpleasant, and he must act promptly on his convictions. Therefore, it is his duty to subordinate the modesty which comes to all men who learn to think straight and to take charge of private and public business when the opportunity arises. The handicap of the college-bred man is a lack of initiative and a too great fear of doing this or that which is below his dignity. This does not apply to the mining engineers, who know that one kind of work is as dignified as another, and that that which is most useful is most dignified.

"Now, there are two things in general that the engineer can do to make toward greater general happiness. We cannot despise moderate wealth so far as it means comforts and luxuries, and a greater average wealth depends to a remarkable degree upon intelligence. Therefore, an increase in education means an increase in average wealth. A great factor in making us all on the average wealthier, is labor-saving machinery and labor-saving devices of all kinds. This is the engineer's job.

"Another thing that mining engineers can do in the direction of the common welfare, is to point out by precept and example that simplicity is as comfortable and as pleasurable as luxury, that it is not necessary to spend for show, and that the world's greatest and most famous men have been men of small means. It is not necessary to outshine one's neighbors in spending to get up in the world. It is not necessary to step on someone else's head in order to rise. The democratic training and mode of thought of the mining engineer will make him realize and practice this, and will make him instruct others in the fact that the best things in life are not to be bought with money."

A Hoover luncheon was given at the Newhouse Hotel, Salt Lake City, on April 7, with a view to organizing a Hoover-for-President club in Utah. Ralph Arnold, vice-chairman of the national Hoover organization, was the guest of honor, and there was an attendance of about seventy, mining men and engineers being well represented among the number. A declaration of principles was signed by those present, advocating Hoover's nomination.

The Dust in Transvaal Mines Improved During 1919

In the Report of the Executive Committee of the Transvaal Chamber of Mines, presented at the annual meeting on March 22, 1920, it is stated that during 1919 the dust-sampling department of that chamber dealt with 37,795 mine dust samples, as compared with 36,621 in 1918. The department carried out six dust-sampling surveys during the year, as a result of which were determined the following dust-content means:

Survey	Milligrams per Cubic Meter
22	2.1
24	2.1
25	2.3
26	2.3
27	3.1
28	2.5
Mean for the year 1919	2.4

The executive committee states that these survey means and the mean for the year continue to show the improving conditions noted in 1918.

In addition to these volumetric surveys, considerable experimental work was carried out with the konimeter, or dust counter, in the course of which 12,269 samples of dust were counted. Experiment regarding the dust created in shaft-sinking were also made.

University of Illinois Seeks Fellows in Mining Engineering

There are now vacancies in the research fellowships of the Engineering Experiment Station of the University of Illinois, and the Mining Department expects to have one, perhaps two, allotted to it if suitable candidates make application. The department has a laboratory equipped for coal-washing, ore-dressing, the study of mine gases and coal dust, rock drilling, coal-cutting and explosives, besides access to the other laboratories of the university. Specially noteworthy are the offerings in industrial chemistry under Professor S. W. Parr in work on coal and coke, as also the special graduate courses in mine economics.

These fellowships are free from all fees save matriculation and diploma, and carry an annual stipend of $500 for two consecutive college years and should lead to the degree of M.Sc. The holder may expect to have half his term time available for graduate study. Additional information may be obtained from Professor H. H. Stoek, Professor of Mining Engineering, College of Engineering, Urbana, Ill.

The annual meeting of the American Welding Society was held at the Engineering Societies Building, 33 West 39th St., New York, on Thursday, April 22.

MEN YOU SHOULD KNOW ABOUT

W. R. Van Slyke, superintendent of fee interests on the Mesabi Range, was in New York recently.

Charles S. Heidel, of the staff of the U. S. Geological Survey, has been appointed State Engineer in Montana.

D. W. Hewett is engaged in making examinations of manganese claims in Cuba for the War Minerals Relief Commission.

J. B. Tyrrell, of Toronto, has been appointed consulting engineer for the National Mining Corporation of London, England.

H. A. C. Jenison has been placed in charge of the copper division of the Mineral Resources Branch of the U. S. Geological Survey.

Joseph S. Diller is making an examination of the asbestos deposits in the Apache and San Carlos reservations in Arizona.

L. K. Armstrong and **John C. Semple**, mining and consulting engineers, have formed a partnership with offices at 720 Peyton Bldg., Spokane, Wash.

Harry Wheelock, formerly of the Socorro M. & M. Co., has been appointed manager of the Oaks Co., which property will be started up shortly.

Arthur J. Collier will be in charge of a U. S. Geological Survey party starting at once to examine the Osage oil field in northeastern Wyoming.

J. F. Berteling, assistant superintendent at the Anvil mine, Ironwood district of the Gogebic Range, Wis., resigned that position on March 31.

Hoyt S. Gale, of the U. S. Geological Survey, is in Buenos Aires, en route to southern Boliva, where he will be engaged in some nitrate investigations.

Frank P. Knight, of Manchester, Mass., president of the Iron Cap Copper Co., is in Globe, Ariz. The company expects to start its new mill there on May 15.

F. J. Bailey, assistant to the director of the U. S. Bureau of Mines, is paying an official visit to all the mine safety stations of the Bureau in the Middle West.

A. W. Allen, formerly Metallurgical and Milling editor of the *Engineering and Mining Journal*, sailed on Wednesday April 21, for Chile on professional consulting work.

Thomas F. Cole, of Duluth, and **Alfred Paul**, of the Calumet & Arizona Copper Co., Bisbee, Ariz., have been looking over copper properties in the Lordsburg, N. M., district.

Roger E. Chase, Jr., Tacoma representative of the firm of I. F. Laucks, assayers and metallurgists of Seattle, has been elected president of the Hoover Club of Pierce County, Wash.

Phillip S. Smith, **Alfred H. Brooks** and **Marius R. Campbell**, of the U. S. Geological Survey, attended the meeting of the Association of American Geographers in New York City.

George Otis Smith, director of the U. S. Geological Survey, will deliver an address May 28, before the American Iron & Steel Institute, in New York, on "Industry's Need of Oil."

James N. Vandergrift, 115 Broadway, returned to New York on April 15. He has spent several months in Peru visiting his copper and coal properties there.

P. S. Smith, administrative geologist of the U. S. Geological Survey, is spending the latter fifteen days of April in a personal inspection trip of the oil and gas areas of Louisiana and Texas.

A. D. Chisholm, assistant manager of the Steel & Tube Co. of America's properties in the Ironwood district of Wisconsin, has been promoted to manager; and **R. P. Zinn** succeeds him as assistant manager.

Walter Harvey Weed, 29 Broadway, New York City, has gone to western Cuba on professional business. Mr. Weed recently stated that "The Mines Handbook" is now expected from the press about May 1.

T. G. Hawkins, Jr., general manager of the Alvarado Mining & Milling Co., left New York April 15 on a tour of inspection of the various properties operated by the Alvarado and other companies of which he is also manager.

Jules Labarthe, of the firm of Bradley, Bruff & Labarthe, 85 Second St., San Francisco, has just returned from a three months' trip to the interior of China, where he has been engaged in professional work.

Dr. Bruce Rose, for some years in charge of important geological surveys in the Rocky Mountains, for the Canadian Government, has left the service to accept a position with the Pearson oil interests.

Cleveland H. Dodge, of New York City, and **J. H. Rea** have been in Douglas, Ariz., as guests of P. G. Beckett, of the Phelps Dodge Corporation staff. **Cleveland H. Dodge, Jr.**, has been a resident of Douglas, Ariz., for a year past.

R. V. Ageton has been transferred from the Salt Lake City station of the U. S. Bureau of Mines, to the district office of that Bureau at Houghton, Mich. Mr. Ageton will there have charge also of the district rescue and first-aid car.

A. E. Redner, superintendent at the Anvil mine of the Steel & Tube Co. of America, has resigned to accept the position of assistant superintendent at the Colby and Ironton mines of the McKinney Steel Co. His successor has not been announced.

G. Perry Crawford, who has been making examinations in the Lordsburg, N. M., district, will sail from New York about May 15 for London, where he is to join a geological expedition to Spitzbergen. The whole summer will be occupied in that work.

Thomas A. Graves was recently in New York. He sailed on April 14 for South America, where he will examine a number of private mining properties during an absence of several months. He may be addressed care of Banco del Peru y Londres, Mollendo, Peru.

Dr. E. L. Bruce, geologist in charge of Canadian Government work in northern Manitoba, has accepted a position with the Whitehall Petroleum Co., for the summer, after which he will become professor of mineralogy at Queens University, Kingston.

George H. Westcott has been appointed manager of the Copper Range Railway, succeeding **Fred Bolles**, who recently resigned to become vice-president and manager of the American Railway Automatic Connector Co. Mr. Westcott was traffic manager under Mr. Bolles.

Arthur L. Flagg, mining engineer of Kelvin, Ariz., and **Arthur Notman**, mine superintendent of the Phelps Dodge Corporation, at Bisbee, Ariz., have been chosen as members of the executive committee of the Southwestern Division of the American Association for the Advancement of Science.

E. L. Cullen, formerly chief mechanical engineer of the Newport and Anvil mines of the Steel & Tube Co. of America, has resigned as manager of their properties in the Ironwood district of the Gogebic Range, a position he has held for the last six years. Mr. Cullen is moving to Milwaukee, Wis., and will take a vacation before resuming work in the mining field.

H. P. De Pencier replaces **C. O. Keading** as general manager for the Dome Mines Co., Ltd., at Porcupine, Ont. **Mr. Dowsett**, formerly mill superintendent, is now assistant manager, and **J. Jordan** is the new mill superintendent, with **Frank Horne** as assistant. The two latter men were in the mill under Mr. Dowsett. Mr. De Pencier is a graduate of McGill University, Montreal, and after graduation spent several years in South Africa. For the last few years he has been third vice-president and acting manager of the Dome Mines Co.

OBITUARY

George S. Patterson, recently appointed general manager for the Northern Ore Co., Edwards, N. Y., was killed in the shaft of the Edwards zinc mine on April 14. Mr. Patterson was struck and crushed by the cage counterweight while taking measurements in the shaft.

THE MARKET REPORT

Published in part in San Francisco and mailed from there to our Western subscribers as a special service pending the arrival of the *Engineering and Mining Journal*

Silver and Sterling Exchange

April	Sterling Exchange	Silver		April	Sterling Exchange	Silver	
		New York, Cents	London, Pence			New York, Cents	London, Pence
15	396¼	118	68	19	394	117¼	68½
16	397	117¾	67¾	20	395	117½	68⅛
17	395	117¼	68½	21	394	117⅜	68⅝

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

Daily Prices of Metals in New York

April	Copper	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
15	18.50@18.75	61¾	62½@63	8.75@9.00	8.60	8.30@8.35
16	18.50@18.75	61½	62 @62½	8.75@9.00	8.60	8.25@8.35
17	18.50@18.75	60¾	62 @62½	8.75@9.00	8.60	8.25@8.35
19	18.50	61	62½@62¾	8.75@9.00	8.60	8.15@8.25
20	18.50	61¼	62 @62¼	8.75@9.00	8.70	8.10
21	18.50	60½	61 @61½	8.75@9.00	8.70	7.90@8.00

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for prompt and nearby deliveries constituting the major markets, reduced to basis of New York, cash, except where St. Louis is the normal basing point. All prices are in cents per pound.

Copper is commonly sold on terms "delivered," which means that the seller pays the freight from refinery to buyer's destination. The delivery cost varies, and it would be confusing to figure net prices on individual transactions. Consequently, an average deduction is made from the "delivered" price. At present the average cost of delivery from New York refineries is 0.15c. per lb., and that deduction is made to arrive at the New York price. When copper is sold f. o. b. or f. a. s. New York, of course no deduction is made.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other special shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. We quote New York price at 35c. per 100 lb. above St. Louis. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin.

London

April	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3 M		Spot	3 M	Spot	3 M	Spot	3 M
15	103½	106½	112	346	344½	38½	41½	48½	50¾
16	102¾	105½	111	343	341½	37¾	40¼	47½	49¾
17	....	....	...	....	....	...	...	...	...
19	102½	105½	110	350	348	37	38⅞	46½	48¾
20	102	105	110	349½	347½	37¼	39	45¾	47¼
21	100¼	103¼	110	344½	342¾	38¼	39¾	45¼	46⅞

The above table gives the closing quotations on the London Metal Exchange. All prices are in pounds sterling per ton of 2,240 lb.

Metal Markets

New York, April 21, 1920.

The railroad strike has probably been chiefly responsible for the lack of interest among consumers of metals during the last week, and the transactions made have been largely between traders. When no one wants to buy, prices ordinarily show a declining tendency, but most producers are willing to wait for conditions to clear up a little. With the strike practically over, freight deliveries should pick up considerably during the coming week, and the metal markets may improve. Any general increase in prices, however, will be held in check by the London market, which, with the exception of lead, seems to have gone all to pieces.

Almost no business was done here in copper. Tin has been quiet, lead fairly active, and zinc hard to dispose of at declining prices. Transpacific freight rates remain unchanged at $12.

Copper

Copper is technically strong, although the price would not lead one to think so. The large producers are, in general, holding firm at 19¼c., delivered, but they are not selling anything. Some smaller producers who have been willing to cut the price have done a little business, and second-hands, by reducing the price down to as low as 18⅜c., have made a few sales. There are rumors that some of the large refineries are picking up a few of the odd lots of metal at low prices to hold until the expected buying movement develops. The large consumers, who are supplied up to July, are sitting back well content to await developments. Their business is excellent, and when they come into the market, which may be any time in the next six weeks, a lot of copper is going to be sold, very likely at an advancing price.

Some refineries have been on the verge of shutting down on account of the recent tie-up of transportation, which prevented them from securing normal supplies of blister and fuel. Conditions should improve rapidly.

Lead

A large tonnage of lead has been sold in the last week for early third-quarter delivery at prices from ⅜ to ½c. under the figures which we quote for April-May delivery. Near-by lead was comparatively scarce. The demand for this metal is exceedingly good, and were it not for the weakness of London, prices would no doubt be higher. One reason for the drop there is the fact that an increased supply is expected on account of resumption of operations at Broken Hill. Some traders are now selling with the idea of buying at a lower figure a little later. Mexican lead is being put on the domestic market, and this also is a factor preventing material price advance.

Zinc

Zinc has dropped considerably in the last three days, traders with international connections having the opportunity to do a lucrative arbitrage business. Today's quotation in London is equivalent to about 7½c., St. Louis. Dealers can therefore buy back in London the American zinc for future delivery which they sold in that market some time ago, thus releasing domestic zinc to fill present orders. No first-hand business to speak of is being done.

High-grade zinc is scarce and obtainable only at a considerable advance over Prime Western. About 9½c., New York, is asked.

Tin

Some buying of tin occurred at the end of last week in the expectation of an early settlement of the railroad strike, but this week has been quiet. The London market took another violent drop today, which had its effect here; 99 per cent tin is not plentiful. Some Chinese No. 1 has been sold recently in the neighborhood of 60c., and this is claimed to be suitable for purposes in which a little lead has no deleterious effect.

We quote electrolytic tin as follows: April 15, 63c.; April 16, 63c.; April 17, 63c.; April 19, 62⅝c.; April 20, 62¼c.; April 21, 61½c.

Straits tin for future delivery: April 15, 61½@62c.; April 16, 61@61⅜c.; April

17, 60½@61c.; April 19, 61½@62c.; April 20, 61¼@61½c.; April 21, 60½@61c.

Arrivals of tin in long tons: April 16, China, 40; April 17, Straits, 125; April 19, Bolivia, 80.

Gold and Silver

Gold was quoted in London on April 15 at 103s. 7d.; April 16, 103s. 7d.; April 19, 105s.; April 20, 104s. 9d.; and April 21, 104s. 9d. On April 1, the amount of gold in the United States amounted to $2,662,284,553, the lowest stock since October, 1916. Gold holdings in this country have now shown a decrease for nine consecutive months. The embargo on exports of this metal was lifted in June, 1918.

Foreign Exchange. — Variations in foreign exchange have been narrow the last week and conditions have been quieter than for some time. In units to the dollar, francs were quoted Tuesday at 16.14 and lire at 21.72. German marks have not so far regained the high figure of two weeks ago, and were quoted yesterday at 1.61c. Exchange on Argentina is now 102.6c. per peso, compared with a normal value of 96.49c. This has resulted in several large gold shipments to that country in an effort to restore the value of the American dollar. Canadian dollars, 9 per cent discount.

Silver.—The silver market has been comparatively steady in the last week. London has been a moderate buyer, with future silver ranging from 2½ to 3d. below the spot price. This concession for futures is influenced by the Eastern exchanges, with rates on the lower basis for forward delivery.

Mexican dollars at New York: April 15, 89¾; April 16, 89¼; April 17, 88¾; April 19, 88¾; April 20, 88¾; April 21, 88¾.

Other Metals

Aluminum—Ingot is quoted at 33c., for 98@99 per cent virgin; good demand; No. 12, 31½c.; sheets, 18 gage and heavier, 44.2c.; powdered, 60@65c.

Antimony—Ordinary brands in fair demand: spot, 10½@10¾c.; futures uncertain but quoted at 11@11½c. in bond; Chinese and Japanese brands, spot, 10¼@10½c. Market easy, with few inquiries; Cookson's, spot, 16c.

[1]**Needle Antimony** — The market for Chinese needle antimony in lump form is firm at 8¾c. per lb., with a rather quiet demand. Standard powdered needle antimony (200 mesh) is quoted at from 11@12c. per lb., according to quantity.

Bismuth—Unchanged at $2.70 per lb. for 500-lb. lots.

Cadmium—The price of $1.40@$1.50 per lb. still holds.

[1]**Cerium Metal** — There has been no change from the price of $8@$9 per lb. in ingot form.

Cobalt—Prices remain unchanged at $2.50@$3 per lb.

Iridium—Quoted nominally at $300; unchanged; metal still scarce.

Magnesium—Metallic, 99 per cent or over pure, $1.60@$1.85 per lb. Unchanged.

[1]**Molybdenum Metal** in rod or wire form, 99.9 per cent pure, is still selling at $32@$40 per lb., according to gage.

Nickel—Ingot, 43c.; shot, 43c.; electrolytic, 45c. No change.

Osmium—Quoted $150@$165 per troy oz. Unchanged.

Palladium Metal—Quoted at $115@$120 per troy oz., 99 per cent pure. Few inquiries but good supply.

Platinum—Little business but good supply of metal; market not overstrong. Quoted at $125@$133.

Quicksilver—Fairly quiet, with fair demand. Quoted nominally at $103 per 75-lb. flask. San Francisco telegraphs $93@$100, firm.

Ruthenium—Market value, $200@$220 per troy oz. Unchanged.

[1]**Selenium**, black, powdered, amorphous, 99.5 per cent pure, continues to be quoted at $1.75@$2 per lb., depending on quantity.

[1]**Thallium Metal**—Selling at $18@$20 per lb., ingot, 99 per cent pure, depending on quantity.

Metallic Ores

Chrome Ore—Situation difficult on account of shortage of boats. Quoted 60@85c. per unit for material containing 35-40 per cent Cr_2O_3 and 70c.@$1.25 per unit for ore running 48 per cent Cr_2O_3 and over.

Iron Ores—Lake Superior ores, per ton delivered at Lower Lake ports, remain at prices fixed last year, as follows: Old Range bessemer 55 per cent iron, $7.45; Old Range non-bessemer, 55½ per cent iron, $6.70; Mesabi bessemer, 55 per cent iron, $7.20; Mesabi non-bessemer, 51½ per cent iron, $6.55. Ore shipments were held up as a consequence of the strike. Prices for Port Henry ores, f.o.b. Port Henry, are as follows: Old Bed 21 furnace, $5.80; Old Bed concentrates, 63 per cent, $6.70; Harmony, cobbed, 63 per cent, $6.70; New Bed, low phos., 65 per cent, $9.50; lump ore for fix, $7.00.

Manganese Ore—Quoted at 75@80c. per unit for ore containing 45 per cent Mn and over for early shipments. Considerable business has been done, although ocean freights are scarce. Chemical ore (MnO_2) quoted at $80@$90 per gross ton.

Molybdenite—No change. Quoted at 75@85c. per lb. of contained sulphide for 85 per cent MoS_2.

[1]**Tantalum Ore**, guaranteed minimum 60 per cent tantalic acid, is still selling at 65@70c. per lb. in ton lots.

Titanium Ores—Ilmenite, 2c. per lb. of 52 per cent TiO_2. Unchanged. Rutile, standard imported Norwegian grade, carrying a minimum of 95 per cent titanium dioxide, in the form of concentrates, is quoted at 11c. per lb.

[1] Furnished by Foote Mineral Co., Philadelphia, Pa.

Tungsten Ore—Little market during past week. Chinese wolframite is quoted at $6.50@$7; Bolivian, spot, nominal, $8.50@$9; scheelite, spot, $15 per unit.

Uranium Ore (Carnotite)—$2.75@$3 per lb. for 96 per cent of the contained oxide (U_3O_8). Ores must contain a minimum of 2 per cent U_3O_8.

Vanadium Ore—$6 per lb for 99 per cent of the vanadic oxide (V_2O_5) contained.

Zircon—Washed, iron free, continues to be quoted at 10c. per lb. Zirkite—In carload lots, $90@$100 per ton is quoted. Pure white oxide, 99 per cent, is quoted at $1.15 per lb. in ton lots.

Zinc and Lead Ore Markets

Joplin, Mo., April 17—Zinc blende, per ton, high, $52.75; basis 60 per cent zinc, premium, $48.50; Prime Western, $47.50; fines and slimes, $45@$42.50; calamine, 40 per cent zinc, $35. Average settling prices: Blende, $51.07; calamine, $38.98; all zinc ores, $50.78.

Lead, high, $110.75; basis 80 per cent lead, $110; average settling price, all grades of lead, $107.10 per ton.

Shipments the week: Blende, 14,925; calamine, 167; lead, 2,425 tons. Value, all ores the week, $1,026,410.

Having large advance purchases subject to shipment when rail embargoes were announced, buyers declined to offer more than $47.50 basis. Few sales were made until today, when several thousand tons were relinquished, but less than half the normal purchase.

Platteville, Wis., April 17—Blende, basis 60 per cent zinc, $57 base for high-grade lead ore; basis 80 per cent lead, $105 per ton. Shipments for the week were: Blende, 1,411; calamine, 120 tons. Shipments for the year: Blende, 23,822; calamine, 1,200; lead, 2,039; sulphur ore, 209 tons. Shipped during the week to separating plants, 2,880 tons blende.

Non-Metallic Minerals

Asbestos—Quoted per short ton f.o.b. Thetford, Broughton and Black Lake mines, Quebec, Canada. Freight rate from mines to Sherbrooke, Quebec, over Quebec Central R.R., 20c. per cwt; from Sherbrooke to New York, 27½c., carload lots. Crude No. 1, $1,750@$2,000; crude No. 2, $1,200@$1,600; spinning fibres, $500@$750; magnesia and compressed sheet fibres, $275@$400; single stock, $95@$150; paper stock, $60@$75; cement stock, $27.50@$32.50; floats, $15@$17.50 per short ton. Unchanged.

Barytes—Pressure of heavy demand and difficulty in transportation still continue to affect general situation. White floated is listed at $35@$40 and off-color at $25@$30 per ton.

Blanc Fixe (Barium Sulphate)—Dry, 4½@5½c. per lb.; pulp, $30@$50 per ton f.o.b. New York.

Chalk—English, extra light, 5@7c. per lb.; light, 4½@6c. per lb.; dense, 4@5c. per lb. f.o.b. New York. Unchanged.

China Clay (Kaolin)—Imported lump, $25@$35 per ton; imported powdered, $30@$60 per ton; domestic lump, $10@$20 per ton; domestic powdered, $25@$40 per ton f.o.b. New York.

Feldspar—Situation remains unchanged with $13.50@$18, ground grade, f.o.b. New York State still holding firm.

Fluorspar—Gravel, f.o.b. S. P. Ry., Lordsburg, N. M., or Rosiview, Ill., or Marion, Ky., is quoted at $25 net ton. Nominal prices: acid grade, lump, $30@$45; acid grade, ground, $52@$57, contracts for acid spar (not less than 97 per cent calcium fluoride and not over 1½ of SiO_2) have been made at $55@$57.50 per ton f.o.b. Rosiview, Ill.

Fuller's Earth—Remains firm at $25@$30 for domestic and $35@$40 for foreign, with little material available at these prices.

Graphite — Present quotations for crucible flake are: 85 per cent carbon content, 7½c. per lb.; 86 per cent, 8c.; 87 per cent, 8½c.; 88 per cent, 9½c.; 89 per cent, 9½c.; 90 per cent, 10½c.; 91 per cent, 10½c.; 92 per cent, 11c.; over 92 per cent, 12½c. per lb. delivered. Mexican amorphous graphite is being sold at $55@$60 per short ton; Korean, 3¾c. per lb.; Madagascar, 9c.; Ceylon, 4¼@16c., according to quality. A Canadian producer claims the best prices obtaining for crucible graphite, guaranteed over 90 per cent carbon, are from 5@7c. per lb.

Gypsum—Wholesale price, plaster of paris in carload lots, is $3.25 per 250-lb. bbl. Sufficient demand, but scarcity of material.

Magnesite—Dead burned, for refractory (see Refractories).

Calcined Magnesite — High-grade caustic calcined, in lump form, is selling at $35@$40 per ton in carload lots f.o.b. California points. The price of freshly ground calcined, suitable for the flooring trade, is $60@$65 per ton f.o.b. Eastern points.

Monazite—Product carrying a minimum of 6 per cent thorium oxide, $42 per unit is quoted, duty paid.

Nitrate—Supplies scarce but quotations remain at $3.90 per cwt., ex vessel, Atlantic ports. Futures $3.90@$4.50.

Phosphate Rock—Prices quoted per long ton at port are: 68 per cent tricalcium phosphate, $6.85; 70 per cent, $7.35; 74 to 75 per cent, $10; 75 per cent minimum, $10.50; 77 per cent minimum, $12.50. Unchanged.

Pumice Stone—Imported, 3@6c. per lb.; domestic, 2½c. per lb. Unchanged.

Pyrites—Consumers are buying as needed and situation shows slight movement upward. Domestic pyrites, fine, has found sales at 16½c. per unit.

Sulphur—Fair demand with prices averaging $18 per ton for domestic, and $20 for export, f.o.b. Texas and Louisiana mines.

Talc—Domestic, $20@$30 per ton; imported, $60@$70 per ton f.o.b. New York.

Ferro Alloys

Ferrocarbontitanium—For 15-18 per cent material, $200@$250 f.o.b. Niagara Falls, N. Y. Unchanged.

Ferrocerium[1]—Conditions abroad continue to cause a reduction in price of the American goods, and this alloy is now selling at $12@$15 per lb.

Ferrochrome—6-8 per cent carbon, 17@18c. per lb. of chromium contained; 4-6 per cent carbon, 19@20c. per lb. of chromium contained.

Ferromanganese—Domestic, prompt delivery, 80 per cent, $225@$250; July to December delivery, $200. English, c.i.f. tidewater, $200.

Ferromolybdenum—Standard grades, carrying from 50 to 60 per cent molybdenum metal, with low sulphur, phosphorus, and arsenic, are quoted at $2.25@$2.75 per lb. of contained metal.

Ferrosilicon—$85@$90, 50 per cent delivered, spot and contract. Electrolytic, delivered Pittsburgh Valleys, Cleveland: 50 per cent, $80; 75 per cent, $140. Bessemer, f.o.b. Jackson, Ohio, 10 per cent, $62.50; 11 per cent $65.80; 12 per cent, $69.10.

Ferrotungsten — 70-80 per cent W, 85c@$1.15 per lb. contained tungsten.

Ferro-uranium—35-50 per cent U, $7 per lb. of U contained. Unchanged.

Ferrovanadium—30-40 per cent, $6.50@$7.75 per lb. of V contained.

Spiegeleisen—Quoted at $62@$65 for 19 to 21 per cent.

Metal Products

Copper Sheets—No change since Jan. 7 price of 29½c. per lb.; wire, quoted 22½c.; strong. Unchanged.

Lead Sheets—Full lead sheets, 12¼c.; cut lead sheets, 12½c. in quantity prices, mill lots.

Nickel Silver—Unchanged at 39½c. per lb. for 18 per cent nickel.

Yellow Metal — Dimension sheets, 26¾c.; sheathing, 25¾c.; rods, ⅝ to 3 in., 23¾c. Unchanged.

Zinc Sheets—$12.50 per 100 lb., less 8 per cent on carload lots, f.o.b. smelter; zinc plates, 12c. per lb. Unchanged.

Refractories

Chrome Brick—Unchanged at $70@$75 per net ton, f.o.b. Chester, Pa.

Chrome Cements—Unchanged at $45@$50 per net ton, f.o.b. Chester, Pa.

Clay Brick—First-quality fire clay, $45@$50 per 1,000, f.o.b. Clearfield, Pa.; second quality, $40@$45 per 1,000, f.o.b. Clearfield, Pa.

Magnesite—Dead burned, $50@$55 per net ton, f.o.b. Chester, Pa.; brick, 9 x 4½ x 2½ in., $80@$85 per net ton, f.o.b. Chester, Pa. Unchanged.

Silica Brick—$50@$55 per 1,000, f.o.b. Mt. Union, Pa.

Iron Trade Review

Pittsburgh, April 20, 1920

Operations of sheet steel mills have been curtailed to about 50 per cent activity, and there appears little chance of improving this ratio. Owing to the accumulations of freight and the lack of fuel, the situation appears to have reached its worst, in so far as transportation is concerned, but it is expected that there will be steady revival of normal output. Buying for new business in the sheet market is at present at a standstill, with mills offering practically no steel and trying to allot their output among customers where deliveries are at all possible. Tinplate mills show about the same ratio of operation as the sheet makers and are in a serious position with regard to fuel supply. Some foreign inquiries for tin plate are being received, but are not yet being quoted for by the makers. The market, however, appears to be quite firmly established on prompt stock from producing mills at $8.25 to $8.75 per base box. Semi-finished steel is selling again, and the trading has shown an ultra conservatism actuating the trades reporting. Some openhearth sheet bars for second-half delivery purchased on the basis of $75 for delivery to a Valley steel company, and bessemer billets were disposed of at $70 f.o.b. mill.

Pig Iron—Resumption of blast-furnace operations appears near enough because of the start the railroads are making to move freight, and this will bring about the completion of deferred negotiations for basic iron this week. Production is very low, for the time, and it is reported that the Carnegie Steel Co. has only twenty-eight of its furnaces blowing, out of fifty-one that were active when the railroad strike began. Generally, not more than 40 per cent of the production is now active. Prices are as follows: Bessemer, $43.40; basic, $43@$44; and grey forge, $42.40@$43.40.

Steel—With increased possibilities for early deliveries, buyers of steel products have become more active. The fact that independent producers were hit harder than the Steel Corporation leads to the assumption that efforts will be made to compete with the leading producers' prices. The demand has increased for car-building material, ship plates, structural steel, and products required by automobile manufacturers. Present prices are as follows: Bessemer billets, $70@$75; openhearth, $70@$75; forging, $80@$90; and sheet bars, $65@@$85.

Charcoal and Coke

Charcoal—Large quantities sell as follows: Willow, 7c per lb.; hardwood, 4½c. per lb., in 250 lb. bbl.

Connellsville — Furnace, $9@$10; foundry, $10@$11.

New River—Furnace, $10@$11, and foundry, $11@$12 per ton.

Pocahontas—Furnace, $10@$12 per ton.

Wise County — Furnace, $10@$12 per ton; foundry, $11@$12 per ton.

[1] Furnished by Foote Mineral Co., Philadelphia, Pa.

COMPANY REPORTS

U. S. Smelting, Refining & Mining Co.

Silver; U. S. and Mexico

The U. S. Smelting, Refining & Mining Co., in the year which ended Dec. 31, 1919, earned $9,465,395, of which $2,824,181 was set aside for depreciation, mineral depletion, Federal taxes, and additional reserves, leaving profits amounting to $6,641,214. Preferred dividends at 7 per cent amounted to $1,702,225, leaving $4,938,989 available for common dividends. Shares of common stock to the number of 351,115 are outstanding, so that $14.07 was earned per share, compared with $5.50 actually paid. The balance of $3,007,857 was added to surplus, which now amounts to $17,330,117. This is about equally divided among (1) ores and supplies on hand; (2) metals in process, and (3) securities, account receivable, and cash. The common stock last year earned 20 per cent and yielded 8 per cent on the present market price of $70.

Of the company's sales, 61 per cent was silver, 11 per cent lead, 10 per cent coal, and 9 per cent gold, so future prosperity would seem to depend largely on the state of the silver market. The Mexican properties of the company seem to be in particularly good condition. The refinery at Chrome, N. J., was disposed of during the year, and the Mammoth mine and smelter in California closed down on May 17.

Phelps Dodge Corporation

The Phelps Dodge Corporation, for the year ended Dec. 31, 1919, reports a production of 103,930,558 lb. of copper, 141,269 lb. of lead, 1,296.93 oz. of silver and 16,269 oz. of gold. Including copper received from other sources, the company sold 149,284,465 lb. at an average price of 17.13c. per lb., New York. Of that amount 137,923,091 lb. was sold in this country and 11,361,374 lb. shipped abroad. This output was only about two-thirds that of 1918, owing to the curtailment forced by the small foreign demand for copper.

On the $45,000,000 capital stock the company earned $7.14 a share. This compares with $22.85 a share in 1917. Dividends disbursed during the year aggregated $4,500,000, or $6,300,000 less than was received in the preceding year.

Consolidated Mining & Smelting Co. of Canada, Ltd.

The Consolidated Mining & Smelting Co. of Canada, Ltd., in the report for the fiscal period of fifteen months ended Dec. 31, 1919, states that 398,118 tons of ore was produced, yielding gold, 59,605 oz.; silver, 1,782,025 oz.; lead, 41,711,147 lb.; copper, 6,933,962 lb., and zinc, 30,743,461 lb. Receipts for the period totaled $13,002,498.76. Mining, smelting, and general expenses were $5,195,640.63; development expenses, $280,271.38, and profit for fifteen months ended Dec. 31, 1919, was $976,065.13. Dividends totaled $1,315,462.50.

Tonopah Mining Co., of Nevada

Gold-Silver

The Tonopah Mining Co., of Nevada, reports net income for the six months ended Feb. 29, 1920, as $22,392.04. Gross value of ore milled was $213,115.05. Mining, milling, marketing, and general expenses were $232,872.01. Loans to subsidiary companies total $2,877,193.80. In consequence of the reduced earnings of the company, due to the labor situation at Tonopah, the directors deemed it best not to declare a dividend at this time.

Inspiration Consolidated Copper Co.

Copper; Arizona

The production of copper by the Inspiration Consolidated Copper Co. during 1919 totaled 78,038,306 lb., which was produced at a cost of 13.412c. per lb., including depletion and taxes. Dividends paid amounted to $7,091,802, of which $2,905,173 was taken from surplus account. Sales of copper were valued at $11,045,221.71. Expenses were $9,887,890.27, and balance (income for 1919) was $4,186,628.45. Surplus at the end of the year is reported as $9,879,259.16. The company received $69,360 in dividends from the Arizona Oil Co., which is owned jointly with the Anaconda Copper Mining Co.

Osceola Consolidated Mining Co.

Copper; Michigan

The Osceola Consolidated Mining Co. for the year ended Dec. 31, 1919, reports that 10,824,331 lb. of copper was produced at a cost of 18.8c. per lb., and 7,766,460 lb. was sold, at 18.65c. per lb. Dividends paid amounted to $288,450. Balance of current assets on Dec. 31, 1919, was $3,053,534.92, as compared with $3,096,507.61 the year previous. During the year, 739,364 tons of rock was treated, at a cost, covering mining, stamping, transportation, and taxes, of $2.21 per ton. Underground work was as follows: Osceola branch, openings, 3,135 ft.; North Kearsarge branch, shaft sinking, 138.5 ft.; openings, 2,833 ft.

Goldfield Consolidated Mines Co.

Gold; Goldfield, Nev.

The Goldfield Consolidated Mines Co., for the year ended Dec. 31, 1919, reports total earnings at $244,849.17. Operating costs were $109,922.67, and this sum, together with other expenses and losses, brings the total up to $1,227,565.41, leaving a balance of $982,716.24 chargeable to surplus account. On Dec. 31, 1919, a dividend of 5c. per share was paid, making total dividends to date $29,177,789, or $8.20 per share. Mining operations were discontinued on Jan. 31, 1919, but were continued under lease by the Goldfield Development Co.

National Lead Co.

The National Lead Co. reports for the year ended Dec. 31, 1919, net earnings of $4,632,560.17, equivalent, after payment of $1,705,732 in preferred dividends, to $14.17 a share earned on $20,655,400 common stock. Common share holders received $1,032,770 in dividends. The surplus on Dec. 31, 1918, was $16,659,907.07, and the sum, added to the 1919 balance, totals $18,553,965.24, the surplus on Dec. 31, 1919.

Franklin Mining Co.

Copper; Michigan

The Franklin Mining Co. reports a production of 1,062,879 lb. of copper during 1919. Production was discontinued in May. Sales of copper totaled $105,240.10, and total mine expense was $330,526.95. Development was as follows: Drifting, 223 ft.; crosscutting, 163 ft., and sinking, 193 ft.

Algomah Mining Co.

Copper; Michigan

The annual report of the Algomah Mining Co., of Michigan, for the year ended Dec. 31, 1919, states that no mining work was undertaken during the year. The company's operations show a deficit for the year of $5,450.

MINING STOCKS

Week Ended April 17, 1920

Stock	Exch.	High	Low	Last	Last Div.
COPPER					
Adventure	Boston	....	....	*75	
Ahmeek	Boston	68	67	67	Mar. '20, $ .50
Alaska-B.C.	N. Y. Curb	2⅛	1⅞	2	
Algomah	Boston	....	....	⅜	
Alloues	Boston	34	33	33	Mar. '19, 1.00
Anaconda	N. Y.	64	61	62⅛	Feb. '20, 1.00
Ariz. Com'l	Boston	13⅜	12⅛	12⅛	Oct. '18, .50
Big Ledge	N. Y. Curb	⅜	....	⅜	
Bingham Mines	Boston	9⅛	7 7/16	9¼	Sept. '19, .25
Boston & Ely	Boston Curb	....	....	*55	
Butte & Bal	Boston	....	....	*30	
Butte & Lond.	Boston Curb	†*15	....	†*10	
Calumet & Ariz.	Boston	65½	64	64¼	Mar. '20, 1.00
Calumet & Hecla	Boston	363	355	360	Dec. '19, 5.00
Calumet & Jerome	N. Y. Curb	....	....	1/16	
Can. Copper	N. Y. Curb	1 1/16	1⅛	1 1/16	
Centennial	Boston	13	13	13	Dec. '18, 1.00
Cerro de Pasco	N. Y.	54⅛	52⅛	53	Mar. '20, 1.00
Con. Ariz	N. Y. Curb	....	....	⅛	Dec. '18, .05
Con. Copper M.	N. Y. Curb	5	4⅛	4⅛	
Chile Cop	N. Y.	19	17⅞	17⅞	
Chino	N. Y.	37⅛	35	35½	Mar. '20, .37½
Cop. Range	Boston	45	43¾	44	Mar. '20, .50
Crystal	Boston Curb	†*27	....	†*26	
Crystal Cop (old)	Boston Curb	†*9	....	†*4	
Davis-Daly	Boston	11⅞	10⅞	11⅛	Mar. '20, .25
East Butte	Boston	15	14½	14½	Dec. '19, .50
First Nat'l	Boston Curb	1 1/16	....	†1⅛	Feb. '19, .15
Franklin	Boston	3⅜	3⅛	3⅛	
Gadsden Copper	N. Y. Curb	1	1	1	
Granby Consol	N. Y.	....	....	49	May '19, 1.25
Greene-Can	N. Y.	37⅛	34	34	Feb. '19, 1.50
Hancock	Boston	5⅛	5⅛	5⅛	
Helvetia	Boston	2¾	2¾	2¾	
Houghton	Boston Curb	†*80	*40	†*55	
Howe Sound	N. Y. Curb	....	....	4	Jan. '20, .05
Indiana	Boston	....	....	*75	
Inspiration Con.	N. Y.	59	55⅝	56½	Apr. '20, 1.50
Iron Cap	Boston Curb	†12	11	†11	Feb. '19, .25
Isle Royale	Boston	34	32	32	Sept. '19, .50
Jerome Verde	N. Y. Curb	....	....	1/16	
Kennecott	N. Y.	31⅞	30⅜	31⅛	Mar. '20, .50
Keweenaw	Boston	....	....	1⅛	
Lake Copper	Boston	2⅛	2⅛	2⅛	
La Salle	Boston	....	....	2⅛	
Magma Chief	N. Y. Curb	1/16	1/16	1/16	
Magma Copper	N. Y. Curb	....	....	38	Jan. '19, .50
Majestic	Boston Curb	*20	*17	†*17	
Mason Valley	N. Y. Curb	....	....	2⅜	
Mass Con	Boston	....	....	5⅛	Nov. '17, 1.00
Mayflower-O. C.	Boston	8⅛	8	8⅛	Feb. '20, 1.00
Miami	N. Y.	24⅛	23⅛	23⅛	Feb. '20, .50
Michigan	Boston	6	6	6	
Mohawk	Boston	67	65	65	Feb. '20, 1.50
Mother Lode(New)	N. Y. Curb	5⅛	5⅛	5⅛	
Nev. Con	N. Y.	14⅞	14½	14⅞	Mar. '20, .25
Nixon Nev	N. Y. Curb	20	16	19	
Nev. Douglas	Boston Curb	†*17	*15	†*16	
New Arcadian	Boston	4	3⅞	3⅞	
New Baltic	Boston Curb	4	3	†3	
New Cornelia	Boston	21⅛	21	21⅛	Nov. '18, .25
North Butte	Boston	21⅛	18⅛	21⅛	Oct. '18, .25
North Lake	Boston	⅜	⅜	⅜	
Ohio Copper	N. Y. Curb	....	....	†*40 1/16	
Oneco	Boston Curb	*100	....	....	
Ojibway	Boston	....	....	2⅜	
Old Dominion	Boston	33⅛	33⅛	33⅛	Dec. '18, 1.00
Osceola	Boston	47	47	47	Mar. '20, .50
Phelps Dodge	Open Market	230	220	...	Apr. '20, 2.50
Quincy	Boston	58	57	57	Mar. '20, 1.00
Ray Con	N. Y.	20	18⅞	19⅛	Mar. '20, .25
Ray Hercules	Boston Curb	....	....	*75	
St. Mary's M. L.	Boston	48	46	47	Dec. '19, 2.00
Seneca	Boston	15	14⅛	14⅛	
Shannon	Boston	1⅛	1⅛	1⅛	Nov. '17, .25
Shattuck-Ariz	N. Y.	11⅛	11	11	Jan. '20, .25
South Lake	Boston	2⅛	2⅛	2⅛	
South Utah	Boston	*15	*15	*15	
Superior	Boston	5⅛	5	5⅛	Apr. '17, 1.00
Superior & Boston	Boston	5⅛	5	5	
Tenn. C. & C	N. Y.	12⅜	11⅛	11⅛	May '18, 1.00
Trinity	Boston	1⅛	1⅛	1⅛	
Tuolumne	Boston	*82	*75	*75	
United Verd. Ex.	Boston Curb	*36	*35	†*35	Feb. '20, .50
Utah Copper	N. Y.	77⅜	74⅛	76	Mar. '20, 1.50
Utah Con	Boston	8⅛	8	8	Sept. '18, .25
Utah M. & T.	Boston	2⅛	2⅛	2⅛	Dec. '17, .30
Victoria	Boston	3	3	3	
Winona	Boston	1⅛	1	1⅛	
Wolverine	Boston	19½	18⅛	18⅛	Jan. '20, .50
LEAD					
Hecla	N. Y. Curb	4⅛	4 1/16	4 1/16	Mar. '20, .15
St. Joseph Lead	N. Y.	17⅛	16½	16½	Mar. '20, .50
Stewart	Boston Curb	†*18	....	†*16	Dec. '15, .05
Utah Apex	Boston	2⅛	2⅛	2⅛	Nov. '18, .25

*Cents per share. †Bid or asked Apr. 17.

Stock	Exch.	High	Low	Last	Last Div.
ZINC					
Am. Z. L. & S.	N. Y.	19	17⅜	18⅛	May '17, 1.00
Am. Z. L. & S. pf.	N. Y.	56	53⅜	53⅜	Feb. '20, 1.50
Butte C. & Z.	N. Y.	9⅛	9⅛	9⅛	July, '18, .50
Butte & N. Y.	N. Y. Curb	⅜	....	⅜	
Butte & Superior	N. Y.	27⅛	25⅜	25⅜	Sept. '17, 1.25
Con. Interst. Cal.	N. Y.	18⅛	17⅛	17⅛	Mar. '20, .50
Natl. Z. & L.	Boston Curb	†*10	*6	†*6	May '17, .02
Success	N. Y. Curb	*6	*5	*5	July '16, .03
GOLD					
Alaska Gold	N. Y.	2⅛	1⅞	1⅞	
Alaska Juneau	N. Y.	2⅛	2⅛	2⅛	
Booth	N. Y. Curb	6	5⅞	6	
Carson Hill	N. Y. Curb	29	26⅛	27⅛	
Cresson Gold	N. Y. Curb	....	....	2⅛	Mar. '20, .10
Dome Ex	Toronto	*27⅛	*26½	*27	
Dome Lake	Toronto	*8⅛	*6	*7	
Dome Mines	N. Y.	11⅛	10	11⅛	Apr. '20, .25
Goldfield Con	N. Y. Curb	*13	*11	*12	Dec. '19, .05
Hedley	Boston	....	....	4½	June '19, .10
Hollinger Con.	Toronto	6.65	6.45	6.45	Apr. '20, .05
Homestake	N. Y.	60⅜	60⅛	60⅛	Sept. '19, .50
Kewanas	N. Y. Curb	*3	*2⅝	*3	
Kirkland Lake	Toronto	*64	*53⅛	*59	
McIntyre Porcupine	Toronto	2.15	2.08	2.09	Jan. '20, .05
Silver Pick	N. Y. Curb	*19	*10	*10	
Teck-Hughes	Toronto	*18	*16	*17	
United Eastern	N. Y. Curb	3⅛	3⅛	3⅛	Apr. '20, .21
West Dome	Toronto	*10	*8⅛	*8⅛	
White Caps	N. Y. Curb	19	14	15	
Yukon Gold	Boston Curb	†1½	1	†1	June '18, .02½
SILVER					
Adanac	Toronto	*4¼	*3⅛	†*3⅛	
Bailey	Toronto	*6	*5⅛	*5⅛	Apr. '16, .05
Beaver Con	Toronto	*55	*47	†*52⅛	
Coniagas	Toronto	3.20	2.85	†2.90	Feb. '20, .12½
Crown Reserve	Toronto	*38	*34	*34	Jan. '17, .05
Hargraves	Toronto	*3⅛	*2	†2⅛	
Kerr Lake	Boston	4⅛	4⅛	4⅛	Sept. '19, 1.00
La Rose	N. Y. Curb	⅜	....	⅜	Apr. '18, .02
McKinley-Dar.	Toronto	†*65	....	....	Apr. '20, .03
Nipissing	N. Y. Curb	10⅛	10⅛	10⅛	Apr. '20, .25
Ontario Silver	N. Y.	8⅛	8⅛	8⅛	Jan. '19, .50
Ophir Silver	N. Y. Curb	⅛	....	⅛	
Peterson Lake	Toronto	*20	*17⅛	*18⅛	Jan. '17, .01½
Sil. King Ariz	N. Y. Curb	*85	*52	*53	
Temiskaming	Toronto	*45	*41⅛	*41⅛	Jan. '20, .04
Trethewey	Toronto	*45	*41	†*41⅛	Jan. '19, .05
GOLD AND SILVER					
Atlanta	N. Y. Curb	*3	*2	*2⅛	
Batopilas	Boston	....	....	1⅛	
Bost. & Mont.	N. Y. Curb	*64	*60	*61	
Cashboy	N. Y. Curb	*9	*7⅛	*9	
El Salvador	N. Y. Curb	3⅛	2⅛	3	
Goldfield Merger	N. Y. Curb	*3⅛	*2⅛	*2⅛	
Jim Butler	N. Y. Curb	*23	*19	*20	Aug. '18, .07
Jumbo Extension	N. Y. Curb	*8⅛	*7	*8	June '16, .05
Louisiana Con	N. Y. Curb	⅛	....	⅛	
McNamara Cr	N. Y. Curb	*⅛	*⅛	*⅛	
Nev. Packard	Boston Curb	*25	....	....	Apr. '19, .02
Rochester Mines	N. Y. Curb	....	....	*18	Oct. '18, .02
Tonopah-Belmont	N. Y. Curb	2 1/16	1 15/16	2⅛	Jan. '20, .05
Tonopah-Divide	N. Y. Curb	2⅛	1 15/16	1⅞	
Tonopah Ex	N. Y. Curb	2⅛	2	2 1/16	Apr. '20, .05
Tonopah Mining	N. Y. Curb	2	1⅞	1⅞	Oct. '19, .15
West End Con.	N. Y. Curb	2	1⅞	1 13/16	Dec. '19, .05
SILVER-LEAD					
Caledonia	N. Y. Curb	*33	*32	*32	Apr. '20, .01
Daly-West	Boston	4⅛	4⅛	4⅛	Apr. '20, .15
Fed. M. & S.	N. Y.	....	....	15	Jan. '09, 1.50
Fed. M. & S. pf.	N. Y.	39⅛	38⅛	39⅛	Mar. '20, .75
Iron Blossom	N. Y. Curb	....	....	⅛	Jan. '20, .02½
Marsh Mines	N. Y. Curb	*21	*18	*19	
Rex Con	N. Y. Curb	*8	*7⅛	*8	
Simon S. L.	N. Y. Curb	....	....	*1⅛	
Stand. S. L.	N. Y. Curb	1/16	⅛	1/16	Oct. '17, .05
Wilbert	N. Y. Curb	5⅛	4⅛	5	Nov. '14, .10
NICKEL-COPPER					
Internat'l Nickel	N. Y.	23⅛	21⅛	22⅛	Mar. '19, .50
Internat'l Nick. pf	N. Y.	87	87	87	Feb. '20, 1.50
QUICKSILVER					
New Idria	Boston	7½	7½	7½	Jan. '19, .25
TUNGSTEN					
Mojave Tungsten	Boston Curb	†*10	*7	†*7	
VANADIUM					
Vanadium Corpn	N. Y.	97	83	94⅛	Apr. '20, 1.50
GOLD AND PLATINUM					
So. Am. G. & P.	N. Y. Curb	....	....	8⅛	
MINING, SMELTING AND REFINING					
Am. S. & R.	N. Y.	69¾	67	68¾	Mar. '20, 1.00
Am. S. & R., pf.	N. Y.	95½	95	95¾	Mar. '20, 1.75
Am. Sm. pf., A	N. Y.	82½	81¾	81½	Apr. '20, 1.50
Natl. Lead	N. Y.	93¾	86½	87	Mar. '20, 1.50
Natl. Lead, pf.	N. Y.	107	107	107	Mar. '20, 1.75
U. S. Sm. R. & M.	N. Y.	70	68	69	Apr. '20, 1.50
U. S. Sm. R. & M., pf.	N. Y.	....	....	47½	Apr. '20, .87½